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Managerial Wealth, Behavioural Biases and Corporate Monitoring: Impact on Managerial Risk Taking and Value Creation in UK High-tech and Low-tech Acquisitions

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ABSTRACT

While the traditional agency model assumes managerial risk aversion and under-investment in high-risk opportunities, the behavioural agency model allows for risk seeking by managers leading possibly to over-risky investments. Corporate governance mechanisms through their disciplining roles can steer managers towards optimal risk and avoid value destruction from either risk-deficit or risk-excess on the part of their managers. None of the existing studies offer a complete picture of managerial risk taking by allowing for both managerial risk aversion and risk seeking. The painting of just such a picture is the primary focus of this thesis. This thesis aims to answer the following two research questions in the context of corporate acquisitions:

1. What are the factors that drive managers to undertake risky projects?
2. To what extent is firm performance related to the optimal or suboptimal risk level of an investment project?

This thesis investigates 289 UK domestic high-tech acquisitions and 289 matching low-tech acquisitions over the period 1993-2000. High-tech acquisitions are argued to be riskier than low-tech acquisitions.

This thesis documents that fixed compensation, annual bonus, and LTIP cash provide few incentives for managers to conduct risky acquisitions. It finds significant evidence that equity-based wealth (such as LTIP shares, stock options and managerial shareholdings) which links managers' wealth to firm stock performance, has a nonlinear incentive effect on managers' selection of acquisition risk. At a low level, it encourages managers to pursue risky acquisitions. However, at high levels it discourages managerial risk taking. This nonlinear effect is mainly contributed to by managerial shareholdings. No evidence is found that stock options make managers select riskier acquisitions. Strong evidence is found that a high level of managerial wealth, which induces managerial risk aversion, can weaken the incentive alignment effect of equity-based wealth. This thesis finds significant evidence that managerial behavioural biases (such as overconfidence, over-optimism, and hubris) boosted by good past performance, firm glamour ratings by the stock market and a flattering media profile induce managers to engage in risky high-tech acquisitions. Corporate monitors are generally ineffective in disciplining managers' selection of acquisition risk. Overall, this thesis concludes that what makes managers take risky acquisitions appears to be the internal factors, i.e., factors that work within managers' inner selves and give them more confidence that they can control risks. External factors such as corporate monitoring devices that try to control managerial behaviour, do not necessarily boost managers' confidence in their risk managing capabilities.

Regarding post-acquisition performance, this thesis documents that UK high-tech acquisitions in the 1990s do not bring any value to acquirer shareholders up to three years after acquisition completion. However, high-risk high-tech acquisitions do not necessarily destroy more shareholder value than low-risk low-tech acquisitions. Acquisitions that are identified as at 'optimal' risk level perform better than under-risk acquisitions. Indeed, more shareholder value is created in acquisitions that are over-risk than acquisitions that are either optimal-risk or under-risk. Therefore, this thesis suggests that many UK acquirer managers during the period over 1993-2000 have foregone valuable but high risk growth opportunities and destroyed shareholder value more by being excessively risk-averse rather than being adventurous in their risk choices.

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Chapter 1

Motivation, Objectives and Outline of the Thesis

1.1 Introduction

The separation of ownership and control has brought about an abundant stream of research in economics, finance and management literature (Berle and Means,1932; Fama and Jensen, 1983; Marris, 1964). The centre of much of this research is the conflict of interests between shareholders and managers (Jensen and Meckling, 1976). Managers as agents of shareholders may make investment and financing decisions that serve their own interests to the detriment of those of shareholders. To counter this conflict, shareholders rely on a range of corporate control devices to promote alignment of their interests with those of managers (Fama, 1980). Examples of these devices are executive compensation contracts, non-executive board of directors, remuneration committees, etc.

One source of the conflict arises from the different risk [1] preferences of shareholders and managers in making investment and financing choices. By holding wealth in well-diversified portfolios, shareholders diversify away firm-specific risk (see footnote 1) and are therefore considered to be risk-neutral. On the other hand managers

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[1] Risk refers to the variability in security returns (Markowitz, 1952). The risk of a security can be divided into market risk and firm-specific risk (Sharpe, 1964). Market risk is the variability of the security return caused by the whole market and therefore cannot be eliminated or reduced. Firm-specific risk is the risk that is unique to the security and can be reduced and nearly eliminated with a properly diversified portfolio. A more detailed discussion about risk and types of risk is provided in Section 2.2 of Chapter 2.

whose human capital is invested in their own firm hold undiversified portfolios. In addition, when managers' money capital is invested in their company's stock, the degree of non-diversification is accentuated. Such a portfolio exposes managers to a high level of both market and firm-specific risk (Jin, 2002). This induces managers to be risk averse. A consequence of this risk aversion is that managers may spend excessive amount of resources on activities which reduce the riskiness of firm returns or pass up valuable but high risk investment opportunities thereby causing shareholders opportunity losses (Smith and Stulz, 1985; Guay, 1999). This is the risk-related agency problem as viewed by traditional agency theory.

A compensation package or equity ownership ('equity ownership' and 'shareholdings' used interchangeably hereafter) that enhances managers' wealth in line with increases in corporate performance or firm stock value has generally been thought of as a solution to the problem of managers pursuing their self-interests at the cost of shareholder value (Baker *et al*, 1988). Annual bonus and long-term incentive plans including LTIPs (cash or share awards)[2] or stock options are rewarded to managers only when managers achieve pre-determined performance benchmarks over a pre-determined period. In addition, the value of LTIP shares and managerial shareholdings increase

[2] Readers should note that in this thesis 'LTIPs' is not the abbreviation for long-term incentive plans. Long-term incentive plans refer to the type of compensation that is tied to multi-year firm performance. LTIPs are a type of long-term incentive plans that are awarded either as cash or shares when directors achieve the performance objectives set in the LTIPs. The other common type of long-term incentive plan is stock options. See Section 2.3.1 of Chapter 2 for the definitions of various types of executive compensation plans.

with firm share value, thus giving managers an incentive to take growth-oriented risky investments to improve firm performance.

In the 1990s, many companies, especially in sectors with high but uncertain levels of anticipated growth and value gains (e.g., Internet, Software). included stock options in their executive compensation plans (Ittner *et al*, 2003). An important characteristic of stock options is that they have a convex payoff structure. Managers who hold company stock options face no downside risk when the stock price falls below the benchmark performance level (i.e., the exercise price) but can reap enormous payoffs when performance far exceeds that benchmark. Stock options are thus intended to encourage managers to make high-risk investment and financing decisions, thereby offsetting managers' risk aversion to firm-specific risk (Smith and Stulz, 1985).

The studies mentioned above imply that performance-related managerial wealth components[3] can alleviate risk-related agency problems. However, other studies raise an opposite view. Annual bonuses whose performance criteria are based on yearly accounting profits, may induce managers to focus on projects that pay back quickly instead of inducing them to focus on growth-oriented long-term risky projects (Narayanan, 1985). Stocks[4] granted through LTIPs or held in managers' equity holdings have a linear payoff structure, that is, every dollar decrease (or increase) in the value of firm stock will cause the value of LTIP shares or managerial shareholdings to decrease (or increase) by one dollar. Such a linear pay-performance relationship may prevent managers from engaging in risky projects that may negatively affect firm stock

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[3] Managerial wealth includes executive compensation and managerial shareholdings (see Section 2.3.1 of Chapter 2).

[4] 'Stock' and 'share' are used interchangeably hereafter.

prices (Smith and Stulz, 1985). Moreover, some researchers such as Marcus (1982) and Ross (2004) argue that a high level of performance-based compensation and managerial shareholdings even including stock options can intensify the concentration of managers' wealth in their own firms and consequently reduce their tolerance for additional firm risk. By and large, this group of studies suggest that the risk-related agency problem cannot be lessened or solved by linking firm performance to managerial wealth.

In summary, it is not certain whether managers can change their attitude from risk aversion to risk seeking under the influence of performance-related compensation or equity ownership. Empirical studies do not provide consistent evidence in support of one view against the other. Therefore, in the traditional agency domain, the risk-related agency problem remains mostly unsolved.

Whilst the traditional agency model focuses on solving the problem of managerial risk aversion and consequently underinvestment in risky projects, the behavioural agency view allows for the possibility that some managers may actually pursue over-risk investments even without a pecuniary incentive to do so. The behavioural agency view states that managers are prone to various psychological biases, for example, overconfidence, over-optimism, and hubris (Roll, 1986; Heaton, 2002; Malmendier and Tate, 2004). Managerial behavioural biases may be manifested in high-risk and speculative investments where managers underestimate the levels of risk involved. Such speculative investment decisions may end up destroying shareholder value. Therefore, in the behavioural finance domain, managers could be risk-seekers without the inducement of performance-related pay.

Combining these two schools of agency theory, the risk-related agency problem can be considered to encompass both underinvestment in risky projects caused by managerial risk aversion and overinvestment in risky projects induced by managerial excessive risk-seeking attitude. How do shareholders ensure that the above mix of managerial risk incentives leads to neither too much risk taking nor too little? Corporate monitoring mechanisms such as external blockholders, non-executive directors, the separate roles of Chief Executive Officer (CEO) and Chairman of Board (COB), as well as the presence of a remuneration committee through their disciplining role can steer managers towards optimal-risk investments and avoid firm value destruction from either risk-deficit or risk-excess on the part of their managers (Wright *et al*, 1996; Hayward and Hambrick, 1997; Core *et al*, 1999; Gugler *et al*, 2003; Malmendier and Tate, 2005a).

None of the existing studies, however, offer a complete picture of managerial risk taking allowing for both risk aversion and risk preference in the attitudes of managers. The painting of just such a picture is the primary focus of this thesis. The most direct approach to examine managerial risk taking is to examine managers' investment behaviour, because risk-averse managers will select low-risk projects while risk-seeking managers will choose high-risk projects. Project risk thus captures managers' risk preferences. This thesis employs managers' selection of acquisition[5]

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[5] The terms 'acquisition', 'merger' and 'takeover' are all part of the Mergers & Acquisitions terminology. In a merger, a new company is created by combining two firms. In an acquisition, the target firm is purchased by the acquirer and ceases to exist. A takeover is similar to an acquisition and also implies that the acquirer is much larger than the acquired. A detailed discussion of their definitions can be found in Sudarsanam (1995). This thesis does not distinguish between them, and the terms are used interchangeably.

risk as a context to examine these issues. The relationships between acquisition risk and various incentives are briefly discussed in the next sub-section.

Determinants of high risk acquisitions

This thesis employs acquisition decisions as the context to examine the impact of managerial wealth components, managers' behavioural biases and corporate monitoring devices on managerial risk taking. Acquisitions are large and visible corporate investments that can significantly alter the risk profiles of acquirers. Diversifying acquisitions are thought to be driven by managerial preference for firm risk reduction (Amihud and Lev, 1981). On the other hand, acquisitions of targets rich in intangible assets, such as R&D capability and patents obviously ratchet up the riskiness of the acquirers (Kohers and Kohers, 2001).

The fifth merger wave in the USA and the parallel fourth merger wave in the UK that occurred over the period 1993-2000 was characterised by a large number of acquisitions of firms operating in high-technology ('high-tech' hereafter) areas such as the telecommunications, computers, the internet, biotechnology, etc. The key common characteristics of those industries are that they often reflect emerging industries that have a high level of intangible assets and focus on the development of new and innovative technology within their respective areas (Ittner *et al*, 2003; Stathopoulos *et al*, 2005). Many acquisitions of high-tech targets were driven by the vision of technology convergence. The value creation logic[6] behind these high-tech acquisitions

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[6] Sudarsanam (2003) identifies three broad sources of value: revenue enhancement, cost savings, and real options that create valuable growth opportunities. Their importance differs in different types of acquisition, for example, cost savings in mergers in mature industries, revenue enhancement in mergers

rests on new growth opportunities as well as revenue enhancements through, say, cross-selling of the merging partners' products and services. Such acquisitions are risky given the large scope for valuation error as well as the uncertainty in the output of the high-technology products (Lev, 2001; Bannert and Tschirky; 2004).

In contrast, low-technology ('low-tech' hereafter) acquisitions happened in industries with low levels of technology and intellectual assets such as R&D, patents etc, are considered to be much safer investments. Examples of low-tech industries are food, retail, and publishing. Value gains to be made by these acquisitions rely less on growth opportunities and more on cost reduction and revenue enhancement that exploit established products and established markets. Cost savings from such acquisitions can be immediately reflected in the profit & loss account in the year of, or subsequent to, the acquisitions. Revenue enhancement is more difficult to estimate than cost reduction. However when it is based on existing products or services, it is easier to evaluate the potential synergies than to calculate the potential gains from new products or services. Taken together, high-tech acquisitions are likely to be considerably more risky than low-tech acquisitions given the dominance of intangible assets and new growth opportunities in the former.

Which firms make which types of acquisitions depends on managerial risk incentives and the discipline of corporate governance. Fixed compensation and annual bonuses may not be able to drive managers to pursue high-tech acquisitions with

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driven by enhanced market power or sharing of marketing capabilities, and real options in mergers of firms that share resources and capabilities, e.g., R & D, intellectual assets in high-tech sectors. These sources of value also differ in acquirers' ability to value acquisitions (valuation risk) and achieve effective post-acquisition integration.

uncertain payback periods but may rather make them favour low-tech acquisitions. Long-term incentive plans might be more successful since they lengthen managers' decision-making horizons to multi-year periods and managers with longer decision-making horizons are more likely to consider projects that have positive earnings in later periods and possibly negative earnings in earlier periods. This is more typical of the cash inflow of a high-tech acquisition than that of a low-tech acquisition. Therefore, long-term incentive plans may make managers favour of high-tech acquisitions than low-tech acquisitions. However not all long-term incentive plans have such an effect on managers. The convex payoff of stock options protects managers from downside investment risk (see previous section). In addition, the stock options are worth more if the firm is riskier[7]. Stock options therefore may drive managers to select high-tech acquisitions whose unpredictable outcomes could increase the volatility of firm stock performance. LTIPs and managerial shareholdings do not provide such an incentive given their linear payoff structure (see previous section). Managers may consider the safer choice, i.e., low-tech acquisitions if they hold a high percentage of LTIPs and ordinary shares in their wealth portfolio. A better explanation of the payoff structures of various managerial wealth components is provided in Section 2.3.2 of Chapter 2 and a more detailed discussion with regard to the relationship between acquisition risk and managerial wealth components can be found in Section 5.4 of Chapter 5.

High-tech acquisitions could also be a consequence of managerial overconfidence/over-optimism/hubris. High-tech acquisitions are more similar in nature to growth options than low-tech acquisitions, i.e., they are associated with

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[7] This is based on the Black-Scholes (1973) option pricing model. The value of stock options is positively related to firm stock return volatility.

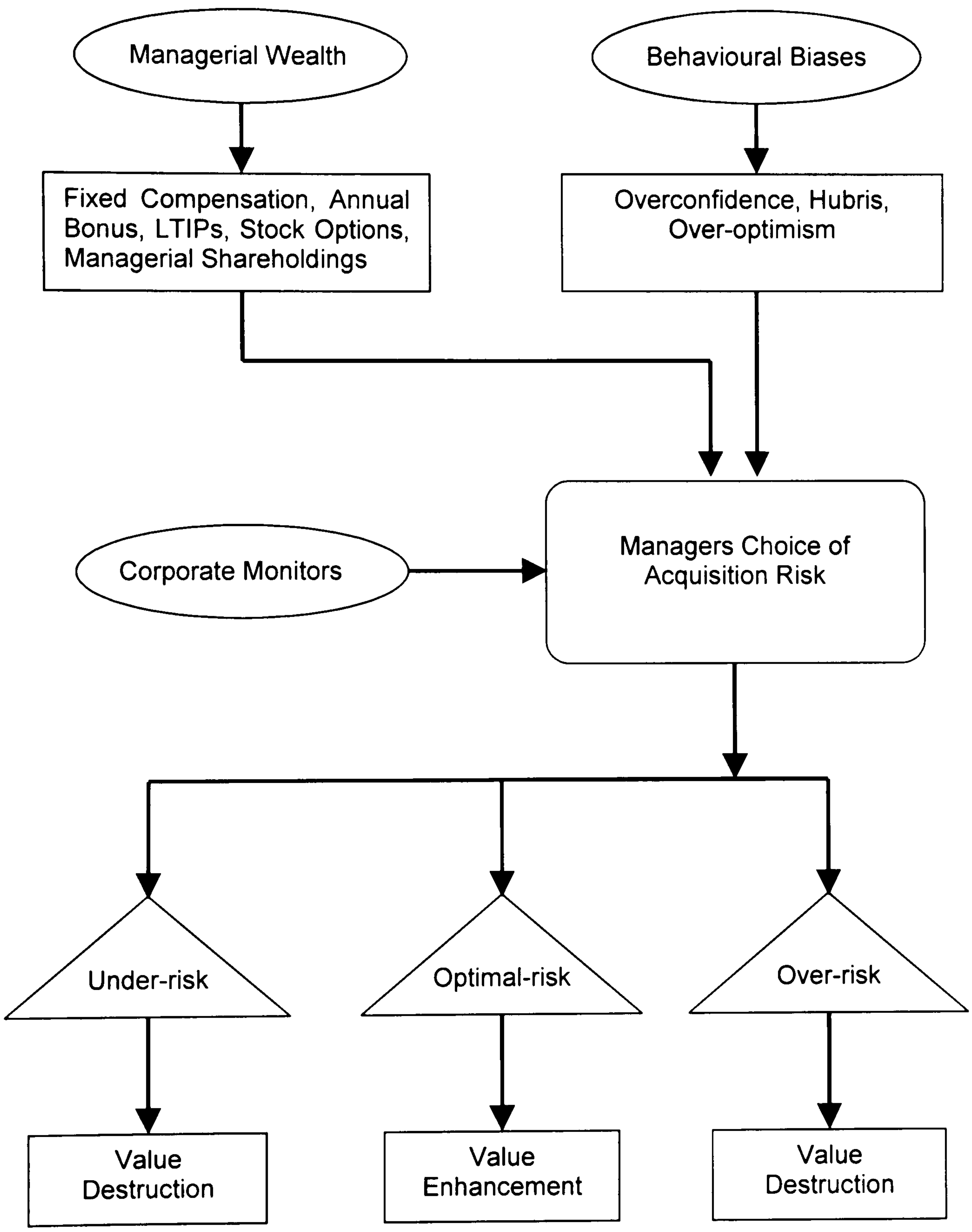
considerable uncertainty, the need to take a view of the future and the contingent nature of the subsequent investments (Smit, 2001). Paradoxically, the contingency of future investments may allow managers simultaneously to be overoptimistic about the upside potential and to downplay the risk because of the option not to make further investment. High-tech acquisitions offering such strategic flexibility may be 'sold' by optimistic and overconfident managers to various internal constituencies, e.g., the board and external constituencies, e.g., analysts and institutional investors. Thus in environments characterised by optimism as was the case during dotcom bubble of the 1990s, many high-tech acquisitions may have been driven by managerial overconfidence/over-optimism/hubris. These behavioural biases may have compounded the problem of valuation risk associated with high-tech acquisitions leading to overpayment for targets and causing acquirer shareholder value losses. More detailed discussions about the relationship between managers' behavioural biases and acquisitions can be found in Chapter 3 and Section 5.5 of Chapter 5.

Robust corporate monitoring can constrain managers to undertake high-risk high-tech acquisitions which will maximise shareholder value and to avoid them when they are considered as excessively risky. Efficient monitoring can also curb managerial risk avoidance through underinvestment in risky acquisitions. A discussion in respect of the relationship between acquisition risk and various corporate monitoring devices is provided in Section 5.6 of Chapter 5.

Shareholder value gains through acquisitions are thus the consequence of the joint impact of managerial wealth, behavioural biases and corporate monitoring. When corporate governance is effective in curbing both managerial risk avoidance and excessive risk seeking, corporate acquisitions under such an influence could be optimal-risk investments which maximize shareholder wealth gains. However, if the risk aversion factors dominate, and the monitors fail to exert a disciplinary function, the resulting acquisitions are likely to be under-risk investments. When behavioural biases dominate, the resulting acquisitions are likely to be over-risk investments. In the both latter cases, acquisitions are likely to be associated with shareholder value destruction.

The theoretical framework of this thesis as discussed above is summarised and illustrated in Figure 1-1. This thesis presents a two-stage analysis. In the first stage, the impact that various components of managerial wealth, behavioural biases and corporate monitors have on managers' selection of acquisition risk is examined. This constitutes the risk model. The risk model emphasizes the interactive nature of those three major factors, which has often been ignored in previous studies. In the second stage, I establish a link between acquirer post-acquisition performance and the optimal/suboptimal levels of acquisition risk, which is derived based on the prediction of the risk model.

Figure 1-1: An illustration of the theoretical framework



1.2 Objectives

Having touched upon the broader issues associated with the thesis above, this section now introduces its specific objectives. Briefly, the aim of this thesis is to answer the following two research questions in the context of corporate acquisitions:

Q1: What are the factors that drive managers to undertake risky projects?

Q2: To what extent is firm performance related to the optimal or suboptimal risk level of an investment project?

To answer these research questions, this study investigates the impact of managerial wealth, behavioural biases, and corporate monitoring on managerial risk taking in the context of UK high-tech and low-tech acquisitions over the period of 1993-2000. More specifically, this thesis has five objectives.

Firstly, it examines how each managerial wealth component, such as fixed compensation and annual bonuses, LTIP cash, LTIP shares, stock options, managerial shareholdings, as well as managers' total wealth can affect the levels of acquisition risk that managers choose to pursue. Various measures that are popular in the existing literature such as stock ownership, delta and vega are used to proxy for the incentive effects of the components of managerial wealth.

Secondly, this study investigates how behavioural biases such as overconfidence, over-optimism, and hubris can affect managers' choices regarding acquisition risk. These biases are proxied by good past performance, glamour status and flamboyant media profiles.

Thirdly, it demonstrates how corporate monitoring through external blockholdings, institutional blockholdings, non-executive directors, the separate roles of Chief Executive Officer (CEO) and chairman of board (COB), and the existence of remuneration committees, can exert disciplinary pressure on managers' acquisition decisions. The above three objectives aim to identify the factors that influence managers choices regarding acquisition risk and to construct an empirical risk model to predict the 'optimal' risk level of an acquisition.

The fourth objective is to investigate the extent to which acquirer performance following acquisitions is related to the acquisition risk chosen by managers. The sample acquisitions used in this study are classified into categories of optimal-risk acquisitions, under-risk acquisitions, and over-risk acquisitions based on the predictions made by the empirical risk model. While optimal-risk investments are theoretically associated with shareholder value enhancement, such positive gains are unlikely to be found with any investment of a suboptimal risk nature. The empirical results for the long-term post-acquisition performance of each acquisition risk category generated based on the predictions of the empirical risk model therefore reflect the performance consequence of the dominant managerial risk preference.

The fifth and final objective of this thesis is to perform a one-stage analysis of the relationship between firm performance and various factors that influence managers' investment behaviour. One-stage analysis is common in the existing finance literature. Examples are Datta *et al* (2001), and Kohers and Kohers (2001). The purpose of the one-stage analysis carried out as part of this thesis is to provide a comparable analysis with those studies which use one-stage analysis, and also to allow a comparison of one-stage and two-stage analyses performed on the same set of source data. To conduct the one-stage analysis, I simply run a regression of acquirer post-acquisition performance on the various risk incentives discussed in objective one to objective three above. A comparison with the one-stage analysis gives visibility regarding the relative strength or weakness of the two-stage analysis used by this thesis.

1.3 Contributions

This thesis offers several contributions to the study of managerial risk taking behaviours in a corporate investment context. Its major contribution lies in the empirical examination of one of the fundamental assumptions of traditional agency theory, i.e., managers are risk averse. It incorporates the behavioural view of agency theory, i.e., that managers can be risk seeking. It provides empirical evidence to support the latter's view and that the risk aversion assumption of the traditional agency theory is inadequate. From the literature survey conducted as part of this thesis, it appears that, this is the only empirical study that provides a comprehensive analysis of managerial risk incentives by combining traditional finance variables with behavioural finance variables.

Allowing for both managerial risk aversion and managerial risk seeking means that managerial risk taking is not always associated with firm value creation as assumed by traditional agency model[8] since both managerial risk avoidance and excessive managerial risk seeking can lead to firm value destruction. This study proposes a two-stage analysis to include managers' selection of acquisition risk into the analysis of the

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[8] Traditional agency theory assumes that managers are risk-averse and shareholders are risk-neutral. The divergence of interests between managers and shareholders creates agency costs that reduce shareholder value (Jensen and Meckling, 1976). Managerial risk-seeking indicates a better alignment of interests between managers and shareholders, and therefore is associated with less agency costs and better firm performance (Wright *et al*, 1996).

relationship between acquirer post-acquisition performance and various risk incentives. A robustness check made against the one-stage analysis which is commonly used in the existing finance literature supports the view that the two-stage analysis adopted by this thesis is superior.

This thesis also makes a number of other significant contributions to the field of agency theory. It contributes to executive compensation literature by providing empirical evidence regarding the efficiency of a variety of compensation components. Indeed, empirical studies are not consistent with regard to the incentive effect of equity-based compensation. This study shows that these incentives actually have considerable disincentive effects. In addition, it adds to the small body of literature, e.g. Mishra *et al* (2000), which suggests that managerial' equity holdings measured by the sensitivity of managers' equity holdings to the change of firm stock price performance, have a nonlinear incentive effect[9]. Moreover, it is the only study demonstrating empirically that a high level of managerial wealth, which intensifies managerial risk aversion, weakens the incentive alignment effect of managers' equity holdings, i.e., the argument put forward by Ross (2004).

From the methodology perspective, this study has more complete data input for Black and Scholes (1973) option pricing model and therefore gives a more accurate estimation of the value of directors' option holdings than most of the existing studies. Existing research on executive stock option compensation is mainly based on US data (Stathopoulos *et al*, 2005). Until around 1998, executive pay research in the UK was hampered by poor data quality due to the lack of detailed company disclosure of

[9] Morck *et al* (1988), and McConnell and Servaes (1990) suggest the nonlinear incentive effect of managerial shareholdings measured by the percentage of shares held by managers.

executive remuneration details. Most of the UK-based research has focused only on the link between cash compensation and corporate performance. However, in response to the recommendations of the Cadbury Report (1992), Greenbury Report (1995), Hampel Report (1998) and other initiatives by official policy makers and other players, including institutional shareholders, the level of disclosure of UK compensation details in company annual reports has increased dramatically. UK annual reports since the 1997 accounting year disclose prior option grants in addition to the current year's grants whereas US annual reports only disclose the current year's grants (Conyon and Sadler, 2001). US studies such as Core and Guay (2002) have to use an approximation approach to estimating the value of historical grants. Therefore, UK data gives a more accurate estimation of the incentive impact of stock options than US data does. However, existing UK-based studies are still limited. Examples are Conyon and Murphy (2000), and Conyon and Saddler (2001), Stathopoulos *et al*, 2005). This thesis therefore provides more evidence to the extant literature regarding the level as well as the effect of stock options by using a more complete set of input data for estimating the value of stock options.

This study is also one of the few UK studies[10] that use the Core and Guay (1999) approach to calculate equity delta [11] of directors' equity holdings, thus provides comparable statistics to those US studies. It is the first UK study to report stock option

[10] The other study is Stathopoulos *et al* (2005).

[11] Equity delta is the sensitivity of the value of managers' equity holdings to the change of firm stock price. See Section 2.3.3 of Chapter 2 for more discussions.

vega[12] of directors' stock option holdings. It probably is also the first study to disclose the level of LTIP cash awards in executive compensation.

Moreover, unlike Conyon and Murphy (2000) and Conyon and Sadler (2001), who restrict their studies to the analysis of CEO compensation, this study extends the analysis beyond the level of CEO and includes data on members of the board. The board is the highest decision making entity within a company. Big corporate decisions such as mergers and acquisitions (M&As) need the approval of all or at least the majority of the board of directors. Focusing on only the CEO underestimates the influence that other board members have on corporate decision-making.

This thesis contributes to the expansion of behavioural finance literature by applying behavioural finance theory to the field of corporate finance. Behavioural approaches are now common in asset pricing, but few studies in corporate finance to date have dropped the assumption that managers are fully rational (Heaton, 2002). One of the major difficulties in testing the behavioural finance theory propositions is the measurement of manager' psychological bias. This thesis addresses this issue by adopting three proxies for behavioural biases, i.e. good past performance, glamour status and media praise. The first two are measured using a quantitative approach and are based on existing literature (see Hayward and Hambrick, 1997; Rau and Vermaelen, 1998; Kohers and Kohers, 2001), whereas the third is measured using a qualitative approach adopted from that of Hayward and Hambrick (1997). The results in this thesis show the significant influence that behavioural biases have on mangers' decision-

[12] Vega is the sensitivity of the value of managers' stock option holdings to the change of firm stock return volatility. See Section 2.3.3 of Chapter 2 for more discussions

making. Recognising the difficulty in accurately measuring psychological biases, this thesis serves as an exploratory study in this field and a foundation for future research.

Moreover, this thesis examines to what extent behavioural biases are linked to acquisition risk, which has been ignored in existing studies such as Roll (1986), Hayward and Hambrick (1997), and Malmendier and Tate (2004). These studies generally just assume that behavioural biases which induce managers to take excessive risk can only lead to value destruction of acquirer shareholders. This thesis however, shows that behavioural biases do make managers take more risks, and furthermore that this risk taking result in better firm performance.

This thesis contributes to corporate governance literature by adding further empirical findings that shed light on the controversial issues of the efficacy of corporate monitoring mechanisms. This thesis investigates the role of monitors such as external blockholders, institutional blockholders, non-executive directors, a non-executive chairman of board (COB) as well as the presence of a remuneration committee and concludes that such monitors are generally ineffective in their disciplinary roles when it comes to managers' risk preferences in corporate acquisitions.

This thesis contributes to M&A literature by examining long-run acquirer shareholder value gains in the most recent and also biggest M&A wave in UK history. One of the major puzzles in acquisitions is the long-run post-takeover underperformance of merged firms (Agrawal and Jaffe, 2000). A vast amount of research has been conducted in an attempt to explain this phenomenon from a variety of perspectives such as acquisition motives, deal characteristics, and research methodology (Sudarsanam, 2003, Chapter 4). By investigating the most recent and biggest merger wave in UK history, this thesis again demonstrates that takeovers in general destroy shareholder value. It also provides a new explanation for such underperformance, i.e., excessive managerial risk avoidance intensified by the nondiversification of managerial wealth portfolio.

In addition, this thesis adds to the limited number of studies on acquisitions of non-public target firms. Those studies such as Chang (1998), Fuller *et al* (2002) and Conn *et al* (2005) generally show that acquirers of non-public target firms if not gain value then at least do not lose value after acquisitions. This thesis however, shows that such acquirers can actually lose substantial amount of value after acquisitions.

In summary, this thesis aims to investigate the impact of managerial wealth, behavioural biases and corporate monitoring on managerial risk taking in the context of UK high-tech and low-tech acquisitions between 1993 and 2000. It contributes to the agency theory by combining the view of both traditional and behavioural agency theory and by allowing for managerial risk seeking behaviour. In addition, it makes contribution to the empirical literature on executive compensation, behavioural finance, corporate governance and long-run post-acquisition performance.

1.4 Outline of the thesis

Chapter 2 reviews the literature relating to the impact of managerial wealth components on managerial risk taking. This review discusses managerial risk preferences within the traditional agency framework and also how various components of the managerial wealth portfolios affect managerial risk preferences. It also presents the empirical measures for the risk incentives provided by these wealth components. Empirical evidence is provided for the impact of each managerial wealth component on managerial risk taking. A critique of the extant compensation literature is provided at the end of the chapter.

Chapter 3 presents the behavioural agency view that managers might be risk prone due to behavioural biases such as overconfidence, over-optimism and hubris. It addresses how behavioural biases may drive managers to take risky projects and provides the empirical evidence for the consequences of such risk taking. Empirical evidence in this area is limited to a very small number of US studies. Overall, these studies show that behavioural biases destroy shareholder value.

Chapter 4 reviews the literature on how corporate monitors, such as external blockholders, institutional blockholders, board composition of non-executive directors, a non-executive COB as well as the existence of a remuneration committee, align the interests of managers to those of shareholders. Opposing perspectives are outlined for each monitor.

Chapter 5 identifies the literature gap based on the previous three chapters and introduces acquisitions as the context for examining the determinants of managerial risk taking. It discusses the risk profile of high-tech acquisitions and develops a number of hypotheses concerning how managerial wealth, behavioural biases and corporate monitoring mechanisms affect managers to take more or less risky acquisitions, as well as how the optimal/suboptimal levels of acquisition risk influence acquirer post-acquisition performance. Summarising the hypotheses, two conceptual models are presented at the end of the chapter: the risk model and the performance model.

Chapter 6 presents the data and methodology adopted in this thesis. Each variable in both the risk model and the performance model is defined and data sources are discussed. The sample selection criteria for both high-tech acquisitions and the matching low-tech acquisitions are presented. The sample distribution of acquisitions is also described. The methodology consists of a five-step analysis, each of which is explained in this chapter.

Chapter 7 provides answers to research question Q1. It first discusses the characteristics of the sample acquisitions and the descriptive statistics of each variable in the risk model. It then discusses the impact of each risk incentive on managers' selection of acquisition risk. Comparison with other related studies and a discussion of the generality of the findings are also provided in this chapter.

Chapter 8 provides answers to research question Q2. It first classifies sample acquisitions based on their risk levels predicted by the empirical risk model reported in Chapter 7. It then presents the long-term post-acquisition performance of acquirers in the sample. The comparative performance of different acquisition risk groups is also discussed. It then uses multiple regression analysis to examine to what extent optimal or suboptimal risk is associated with post-acquisition performance. Finally, it presents a one-stage analysis of the relationship between post-acquisition performance and various risk incentives by running regressions of long-term post-acquisition performance on the risk incentives.

Chapter 9 is a summary of the thesis. It also discusses the implications and limitations of this piece of research and suggests recommendations for future research.

Chapter 2

Managerial Wealth and Managerial Risk Taking: Theory and Empirical Evidence

2.1 Introduction

In 1932, Berle and Means discussed the evolving separation of ownership and control, and questioned whether managers would maximise shareholder wealth by undertaking growth-oriented risky projects in light of this separation. Shareholders, the owner, are risk neutral with regard to firm-specific risk (i.e. the risk that is unique to a company) [13] while managers, the agent, are risk averse because their human capital is concentrated in one firm. Risk-averse managers therefore are likely to under-invest in risky projects that would increase the volatility of company performance so as to secure their jobs, future income as well as human capital investment in their firms. This however is not in the best interests of shareholders because they want managers to undertake all positive net present value (NPV) projects regardless of their risk levels (i.e. the distributions of the expected returns of the projects)[14]. This generates the risk-related agency conflict between shareholders and managers.

A vast amount of research following Berle and Mean (1932) tries to explain the agency conflict and suggests that one way to mitigate the conflict is to provide managers with wealth incentives such as compensation contracts and share ownership. However, depending on the payoff structure, different wealth incentives have different

[13] Detailed discussions about firm-specific risk are in Section 2.2.

[14] The definition of 'risk' is provided in the next section, Section 2.2.

risk incentive effects on managers. Empirical studies since Jensen and Murphy (1990) suggest that the sensitivity of managerial wealth to firm stock performance captures the risk incentive effect of the components of managerial wealth. Some researchers however, argue that increasing the proportion of managers' wealth associated with their employer firms intensifies the concentration of their wealth portfolios and consequently increases their risk aversion.

This chapter presents the theory and empirical evidence related to the relationship between managerial wealth and managerial risk taking. It starts with the discussion of the risk-related agency problem in Section 2.2. The definition of risk is also provided in this section. Section 2.3 first lists the components of managerial wealth and discusses how the payoff structures of these various components can influence managers risk taking behaviour. The managerial incentives for risk taking provided by the components of managerial wealth are termed as wealth incentives. The empirical measures for the wealth incentives are discussed and their associations with managerial risk taking are addressed separately in subsections. Section 2.4 presents a different school of argument that states that whatever the payoff structures are like, executive compensation and equity ownership can only intensify the concentration of mangers' wealth portfolio and consequently increases their risk aversion. Section 2.5 provides a critique of the extant studies and addresses an apparent literature gap in the area of studies relating to managerial risk taking and managerial wealth. Section 2.6 summarises the whole chapter.

2.2 Risk-related agency problems

Within the economic framework, risk is conceptualised as a probability distribution of returns. The larger the variance in expected returns, the larger the risk

(Markowitz, 1952). When faced with two choices having the same expected return, one with a certain outcome and the other without, risk-averse individuals are assumed to prefer the former. A corollary of this is that they demand higher expected returns to compensate for investments involving higher risk.

In modern portfolio theory, the risk of a security is divided into market risk and firm-specific risk (Sharpe, 1964). Market risk, also referred to as systematic risk, encompasses interest rate risk, inflation risk, force majeure (e.g. the September 11th terrorist attack in the US), etc, and therefore cannot be eliminated or reduced by investors, no matter how well the investor diversifies his investment portfolio. Firm-specific risk, or non-systematic risk, is the risk that is unique to a particular security and can be associated with such risks as business, financial, and liquidity, etc. An investor can diversify away the firm-specific risk of a particular security by holding a sufficiently large basket of assets. Modern portfolio theory thus enables agency theory to relax the risk aversion assumption on shareholders.

Agency theory of the firm presents a model of the conflict of interests between shareholders and managers following the separation of ownership and control in modern corporations[15] (Jensen and Meckling, 1976). Shareholders, as principals, are able to diversify their shareholdings across firms and as a result become neutral towards firm-

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[15] Agency theory of the firm also models the relationships among other stakeholders such as debt holders, shareholders and managers (Jensen and Meckling, 1976). This thesis only focuses on manager-shareholder conflicts and emphasizes the difference in risk preferences between shareholders and managers.

specific risk[16]. However, managers, as agents, are still considered to be risk averse to not only market risk but also firm-specific risk. Given that a firm with higher firm-specific risk is associated with a higher probability of bankruptcy, managers are risk-averse to firm-specific risk since their employment security and income are tied to one firm (Berle and Means, 1932; Jensen and Meckling, 1976; Fama, 1980). In addition, managers may also hold shares in their companies, but are constrained by company policies in their ability to diversify their equity portfolios outside their own firms (Jin, 2002). This accentuates the concentration of managers' human and money capital in one firm and makes them more risk-averse to firm-specific risk. More discussion related to the nondiversification of managerial wealth portfolio is provided in Section 2.4.1.

This divergence of risk attitude in terms of firm-specific risk between shareholders and managers can give rise to risk-related agency problems (Smith and Stulz, 1985; Guay, 1999). Shareholders would like managers to invest in all positive NPV projects, irrespective of the risk associated with those projects. Managers, however, may choose to abandon some positive NPV projects that would increase firm risk and consequently increase the risk of firm bankruptcy. By doing so, managers secure their jobs, income and other pecuniary returns. The loss from valuable projects bypassed by managers due to their risk avoidance is a risk-related agency cost (Guay, 1999). Persistent under-investment in risky projects[17] is likely to make those firms

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[16] Given that market risk or systematic risk cannot be diversified away, shareholders are still considered to be risk-averse to market risk.

[17] This underinvestment problem is somewhat different from the underinvestment problem described by Myers (1977). In the model by Myers (1977), equity holders may forgo positive NPV projects if the

gradually lose competitive advantage. This problem is likely to be most severe in firms with abundant growth opportunities such as high-tech firms which rely on high-growth and high-risk investments to gain competitive advantages (Milgrom and Roberts, 1992, Chapter 3).

2.3 Managerial wealth components and risk incentives

The previous section introduces the risk-related agency problem faced by firms with diversified owners and undiversified managers. To reduce this principal-agency conflict, shareholders employ several corporate control devices such as external blockholdings, non-executive directors, board subcommittees, etc. One of the corporate control devices is executive compensation. However, it is not universally agreed that all compensation contracts are effective in aligning the interests of managers and shareholders. This section describes how this issue has been dealt with in the existing theoretical and empirical literature. Following the identification of the components of managerial wealth portfolios in Section 2.3.1, Section 2.3.2 discusses how various payoff structures of these components can influence managers' attitude towards selecting risky projects. To examine the impact of wealth incentives, the empirical literature uses several measures for those incentives. These measures are explained in Section 2.3.3. Section 2.3.4 presents the empirical evidence on how the components of managerial wealth incentivise managers to pursue high-risk investment projects.

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gains accrue primarily to debt holders. The underinvestment problem described by Guay (1999) does not involve debt holders, but instead derives from risk-averse managers that are poorly diversified with respect to their firm-specific risk.

2.3.1 *Managerial wealth components*

The separation of ownership and control creates information asymmetry between shareholders and managers. Shareholders, as outsiders, do not observe all managerial actions and details of investment opportunities. Therefore, they often do not know what actions managers can take or which of these actions will increase shareholder wealth. In this situation, shareholders' ability to monitor whether a project chosen by managers is optimal or suboptimal with regard to its risk level is limited. It is thus in the interests of shareholders to design appropriate corporate governance mechanisms to drive managers to select value enhancing risky projects (Jensen and Meckling, 1976; Fama and Jensen, 1983; Lambert, 1986).

Executive compensation which links a portion of managerial wealth to firm performance, is a key corporate control device (Jensen and Meckling, 1976; Baker *et al*, 1988; Murphy, 1999; Core *et al*, 2003). There are mainly three types of compensation contracts.

1. Fixed compensation (i.e. any contractually guaranteed pay), such as basic salary, fees paid to non-executive directors, pension contributions and other related benefits;
2. Short-term incentive plans, such as annul bonuses which are tied to yearly accounting performance;

3. Long-term incentive plans, including LTIP cash or share awards (LTIPs) and stock options[18]. Long-term incentive plans are typically tied to multi-year firm performance, either accounting-based or stock market-based.

More detailed discussions about each of those compensation contracts such as how they are awarded and what kind of incentives they provide are in Section 2.3.2. The following paragraphs mainly describe how each of these compensation contracts contributes to managerial wealth portfolio and the change of the structure of managerial wealth portfolios in the 1990s.

Fixed compensation and annual bonus are mainly in the form of cash. They are also called 'cash compensation'. This thesis uses the term 'fixed compensation and annual bonus' and 'cash compensation' interchangeably. Cash compensation is a major part of managerial compensation. Using a sample of 478 US companies, Hall and Leibman (1998) report that in 1980, the average CEO cash compensation was \$0.66 million as compared to \$0.81 million total compensation. In 1989, cash compensation rose to \$1.06 million and the total compensation rose to \$1.6 million. The dominant position of cash compensation as part of total executive compensation, however, has been threatened by equity-based compensation (i.e. LTIP shares and stock options) in the 1990s given that equity-based compensation is believed to have a better incentive alignment effect than cash compensation. Briefly, equity-based compensation links managers' wealth to company's stock performance whereas cash compensation makes no such link. Managers who would like to increase the value of their equity holdings

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[18] In this thesis, long-term incentive plans and LTIPs are two different concepts. Long-term incentive plans refer to all the compensation contracts that are tied to multi-year firm performance. LTIPs refer to LTIP cash and share awards, both of which are a part of long-term incentive plans.

are incentivised to improve their firms' stock performance. Thus equity-based compensation aligns the interests between shareholders and managers by turning managers into owners of their firms (Jensen and Meckling, 1976). More detailed explanations can be found in Section 2.3.2.

In the US, executive compensation has grown by leaps and bounds over the last two decades mainly due to the dramatic growth in equity-based compensation, stock options in particular (Bebchuk and Fried, 2004, Chapter 5 and Chapter 6). Equity-based compensation has increased not only in terms of its value but also in terms of its proportion of total compensation. According to Hall and Leibman (1998), one-third of total CEO compensation was in the form of stock option awards as of the mid-1990s in the US, up from one-fifth during the 1980s. They report that between 1980 and 1994 the mean value of stock option grants rose by 683% from \$0.16 million to \$1.2 million in contrast with a 97% growth in CEO cash compensation. For a total sample of 1,788 firms included in three major stock exchanges in the US, New York Stock Exchange, NASDAQ and American Stock Exchange, Bryan *et al* (2000) document that equity-based compensation accounted for up to two-thirds of total CEO compensation in 1997, up from around half in 1992. In addition, they find that on average only 54% of their sample firms granted stock options in 1992 and the percentage increases to 72% in 1997. Examining the compensation of the CEOs of the Standard & Poor ('S&P' hereafter) 500 Industrial firms, Hall and Murphy (2002) report that the increase of the median CEO compensation level from less than \$2 million in 1992 to \$6 million in 1999 is mainly caused by equity-based compensation, which swelled from 30% to 56% of total compensation, i.e. from \$0.6 to \$3 million. This represents a six-fold increase in dollar terms. Most of the increase in equity-based compensation reflects the growth in stock option grants, which grow from 23% to 47% over the same period.

Bryan *et al* (2000) also report statistics for LTIP shares which they term as 'restricted stocks'[19]. Unlike stock options, LTIP shares did not experience a dramatic increase between 1992-1997. The average proportion of their sample firms that granted restricted stocks only rose 1% to 19% in 1997 as compared to 1992. The ratio of the value of restricted stocks to cash compensation remained around 0.16 from 1992 to 1997. In comparison, the ratio for stock options increased from 0.84 to 1.88 over the same period. Hall and Murphy (2002) draw a similar conclusion to Bryan *et al* that LTIP shares did not grow as much as stock options in the 1990s. Hall and Murphy report that the value of LTIP shares as a percentage of total CEO compensation increased only slightly, 7.0% to 7.5%, from 1992 to 1999. The above evidence shows the growing popularity of equity-based compensation in the US in the 1990s, but the substantial increase of equity-based compensation is mainly contributed by stock options.

The UK also experienced a dramatic increase in long-term incentive plans in the 1990s compared to the 1970s. Main (1999) reports that in the 1997 accounting year, around 68% of the 510 largest UK companies offered stock option plans to their top executives, up from around 10% in 1978. Conyon and Murphy (2000) rely on the estimation of the Hemmington Scott database of the total number of options held by CEOs[20]. For a sample of 395 companies, Conyon and Murphy (2000) document that

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[19] Different terms for describing LTIP shares in the US and UK are explained in Section 2.3.2.3.

[20] UK option data prior to 1997 accounting year are not publicly available. Section 6.2.1.2 of Chapter 6 discusses the UK option disclosure requirements in company annual reports.

the median CEO option *holdings* [21](measured as the number of shares under stock options as a percentage of outstanding common equity) increased from 0.09% in 1991 accounting year to 0.11% in 1997 accounting year. The above evidence shows that although equity-based compensation became more popular in the UK in the 1990s, its popularity however still falls far behind that in the US over the same period.

Based on the 510 largest UK companies (ranked by market capitalisation) in the 1997 accounting year when there were detailed option data available to calculate the value of CEOs' option holdings, Conyon and Murphy report the median (mean) CEO total compensation[22] as £414,000 (£589,000). Stock option grants are on average only 10% of the total compensation and LTIP shares are about 9%[23]. Therefore Conyon and Murphy state that equity-based compensation is still a very small part of CEO compensation in the UK. The major compensation component is still cash compensation, about 77% of the total pay. This forms a very big contrast with US compensation structures. The US sample in Conyon and Murphy (2000) is based on 1,666 CEOs from S&P's ExecuComp database in 1997. The median (mean) US CEO total pay is £1.5[24] million (£3.6 million). The value of stock option grants is on average 42% of the total compensation and 4% for LTIP shares. Cash compensation is on average 46% of the total pay. Conyon and Murphy's US findings are similar to other

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[21] Option *holdings* include not only options granted in the current year but also those granted in the past years but have not been exercised.

[22] According to Conyon and Murphy (2000), total compensation, or total pay is the sum of salaries, annual bonuses, benefits, share options (valued on date of grant using the Black and Scholes (1973) formula), LTIP cash and LTIP share awards granted in 1997 accounting year.

[23] Here both stock option grants and LTIP shares refer to those granted in 1997 accounting year only.

[24] Conyon and Murphy (2000) applied exchange rates varied between $1.61 $/£ and 1.65 $/£.

US evidence discussed above, indicating that equity-based compensation was the dominant executive compensation components in the 1990s. Moreover, the pay level of UK equity-based compensation fell substantially behind that of the US, contributing to an overall lower level of UK executive pay than in the US[25].

LITP cash award also contributes to managerial wealth portfolios, but is not as popular as any of the compensation types discussed above. LTIP cash is less common in the UK than in the US (Stathopoulos *et al,* 2005). My literature review has not found any studies reporting any statistics for the level of LTIP cash awards in the UK, or even in the US.

The accumulation of executive compensation year by year contributes to managers' wealth portfolios. After exercising previously granted stock options or LTIP shares, managers can hold a large amount of company ordinary shares. These shares

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[25] Conyon and Murphy (2000) provide explanations for this difference. It can be due to tax, economic, political and cultural factors. Firstly, different tax regimes in the US and UK affect the structures of executive compensation contracts in both countries. Under both tax regimes, executive stock option schemes are classified into 'approved' or 'non-approved'. Approval of a scheme allows the deferral of any personal tax liabilities, with option gains being taxed not at the time of exercise but only once the shares obtained through the option exercise are sold. 'Approved' options are taxed at capital gain tax. The tax rate is as high as 40% in the UK while only 20% in the US. This high tax rate in the UK makes stock option grants less favourable to directors than in the US. Secondly, the US stock market performed better than UK stock market from 1990 to 1997. US stock market therefore created more demand for stock options than the UK market since stock options in the US were considered creating more incentives for directors to create value for shareholders. Thirdly, a variety of statutory and non-statutory arrangements in the UK discouraged stock option grants. For example, Greenbury Report (1995) encouraged companies to replace stock option grants with LTIP scheme. More detailed discussions with regard to those factors can be found in Conyon and Murphy (2000).

give managers voting rights and allow them to be more influential in executing corporate decisions that will protect their wealth in their firms[26]. Managers can also acquire these shares through the market, adding to their shareholdings or equity ownership of their firms. Conyon and Murphy (2000) provide statistics to show that managerial shareholding is a major part of managers' equity holdings. Based on a sample of the 510 largest companies (ranked by market capitalization) in the UK and 1,666 companies in the S&P indices in the US, Conyon and Murphy report that the average value of the shareholdings for UK CEOs is £7 million and for US CEOs is £60 million in 1997. Managerial shareholding of outstanding common equity for UK CEOs on average is 2.13% and for US CEOs is 3.10%. In comparison, the average option holding is only 0.24% for UK CEOs and 1.18% for US CEOs. In the UK, the level of LTIP share grants are about the same as the level of stock option grants, but the former is only a quarter of the latter in the US. These statistics show that managerial shareholding is the major component of managers' equity-based wealth in both countries, particularly in the UK.

There are other components of managerial wealth portfolios such as property, shareholdings in firms other than the firm managers are working for, etc. Cash compensation from previous years may facilitate these investments. A complete analysis of managerial wealth should include all of those components. This however is in the main infeasible due to data availability limitations. Existing literature therefore generally does not include them in estimating the managerial wealth portfolio (Guay,

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[26] Section 2.3.4.2 presents the argument that a high level of managerial shareholdings can lead to managerial entrenchment, i.e., the voting rights carried by those shares give managers more power to execute corporate decisions to satisfy their own interests but may be to the detriment of shareholder value.

1999). The portfolio generally consists of cash compensation, LTIP cash awards, equity-based compensation and managerial shareholdings accumulated over time. The latter two are called 'equity-based wealth' in this thesis given that both of their underlying assets are company shares.

Equity-based wealth and annual bonus link managers' wealth to firm performance. This provides an incentive for managers to undertake high risk, positive NPV projects in order to improve their personal wealth. Some agency theorists believe that this can lessen the divergence of interests between shareholders and managers (Jensen and Meckling, 1976). However, others argue that the effect depends on the payoff structure of each component and therefore, not all wealth components may be equally effective in aligning the risk preferences of shareholders and managers (Smith and Stulz, 1985; Guay, 1999). In the next section, the payoff structure of each of the managerial wealth components is discussed.

2.3.2 Payoff structure of managerial wealth components

Following the argument raised in the last section this section explores the relationship between the payoff structures of various wealth components and the various effects they have on managerial risk incentive.

2.3.2.1 Fixed compensation

Fixed compensation mainly includes basic salary, fees, pension contributions and other benefits. Factors that determine the level of fixed compensation granted to a director include the director's responsibility and seniority, the market salary level for similar jobs in comparable companies, etc.

Fixed compensation is usually detached from firm performance. Therefore it has an almost flat payoff structure. It attracts managers to the firm and protects them from factors beyond their control, such as poor *ex post* outcomes from strategies that, *ex ante*, appear promising. However, such a payoff structure and protection function create zero incentive for managers to increase firm risk because they value preservation of assets more than creating new wealth. (Larcker, 1983; Bainbridge, 2005). A high level of fixed pay drives managers to avoid risk in order to safeguard their jobs and income (Lambert *et al* ,1991).

Assessing and managing a risky project involves much more managerial effort than a safe project. If the risky project fails, managers may lose their jobs or at least acquire a bad reputation that will negatively affect their career progress as well as future income. If the project succeeds, their fixed pay does not increase substantially in relationship to the extra effort they exert or the increase in returns the project may bring to the company. Such an asymmetric outcome associated with fixed compensation can only exacerbate managerial risk avoidance.

2.3.2.2 Annual bonus

Annual bonus often ties managers' remuneration to yearly accounting numbers, such as profit, return on capital employed and earning per share. No bonus is paid until the threshold performance is achieved.

The performance threshold embedded in annual bonus can encourage managers to undertake positive NPV projects that help managers to achieve their bonus awards. However, for senior managers who have strong decision-making power, annual bonus may actually induce counter-productive behaviour (Bebchuk and Fried, 2004, Part III). Given that the performance criterion is based on yearly accounting numbers, annual bonus may drive managers to focus on projects that pay back quickly and sacrifice firm value enhancement brought about by long-term risky projects (Narayanan, 1985; Narayanan, 1996).

Narayanan (1985) demonstrates in his theoretical model that managers select projects yielding short-term profits to improve the perception of their ability early on and hence their chances of earning higher bonuses. This potential advantage to managers could outweigh the fact that from the long-term point of view the project is not the one with the highest NPV and the not one that could enhance firm core competence.

Narayanan (1996) proposes another theoretical model which compares the impact that all-cash compensation and all-stock compensation can have on the managerial decision horizon. As in his paper written in 1985, Narayanan concludes that cash pay drives managers to under-invest in the long run because the critical measure for awarding the cash pay is whether managers are able to improve the firm's annual profits. Managers however can boost the firm's annual profits by selecting projects that yield short-term profits, or simply by manipulating accounting numbers. This is less likely to happen with stock compensation since it is based on managers' performance as manifested in the stock price of the firm. Stock price reflects the expected value of the firm's future cash flow, and is thus less subject to the earnings management.

2.3.2.3 LTIP (cash or share) awards

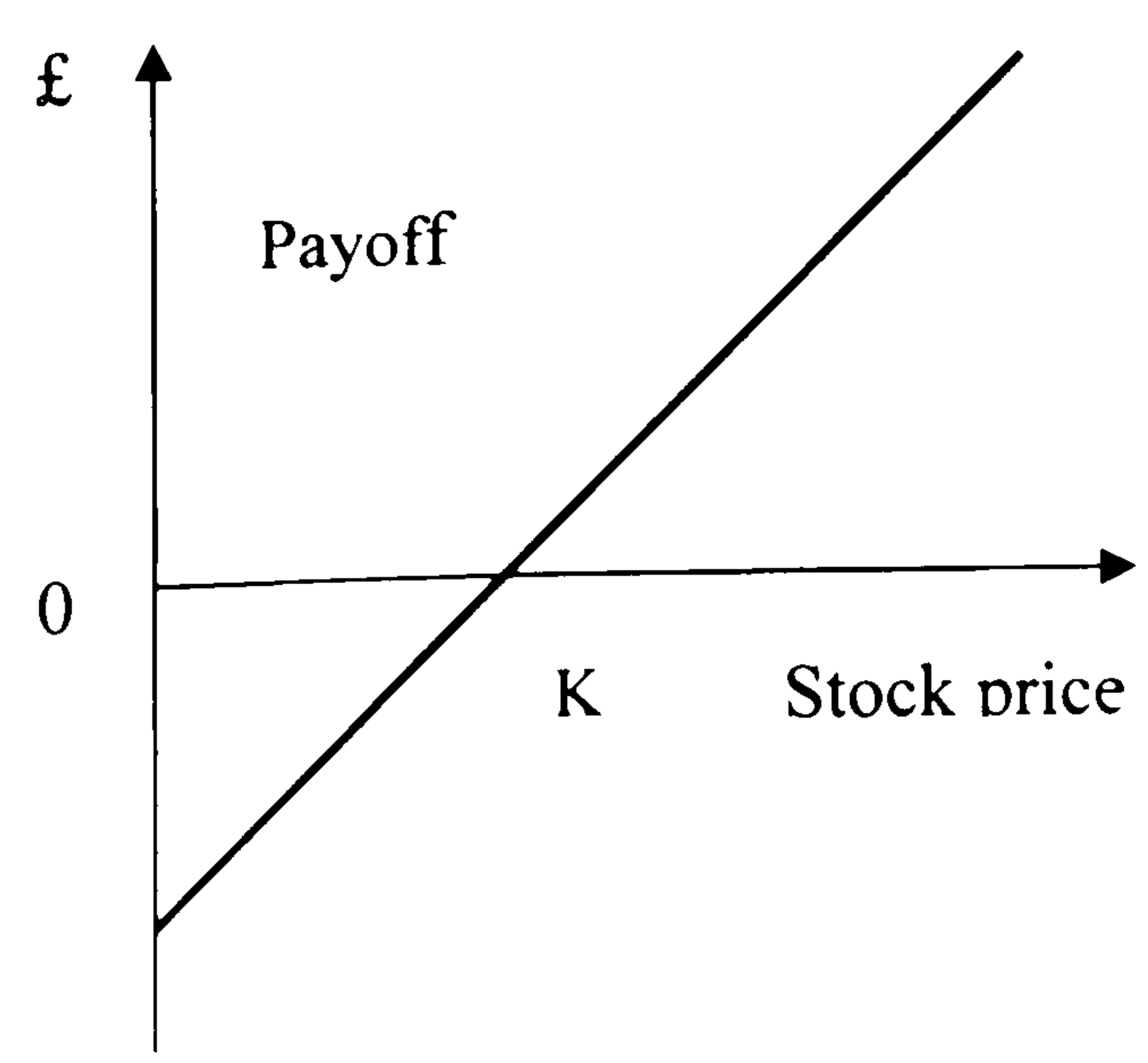
A remedy to the short horizon problem raised by cash compensation is to provide managers with long-term compensation plans such as LTIP (cash or share) awards and stock options (see next section for the discussion about stock options) (Narayanan, 1996). Such plans lengthen managers' decision-making horizon to a number of years since the compensation is deferred until the end of the vesting period (see below for more discussion). Thus managers will invest in projects whose payoff is long-term and hence likely to be more risky.

In the UK, LTIPs are normally awards or grants of shares that become vested, i.e. ownership is transferred to directors, only upon attainment of a certain performance objectives over a period of time, generally three years (Martin *et al*, 1995; Conyon and Murphy, 2000). There are three conditions for the LTIP share awards ('LTIP shares' hereafter) before they can be transferred to directors. First condition relates to the performance objective, either accounting-based or stock market-based. The objective has to be achieved at the end of a specified period of time, i.e. vesting period. Vesting period therefore is the second condition. Ownership of the LTIP shares can only be transferred at the end of the vesting period. The third condition is the leaving constraint. Directors lose unvested LTIP shares if they leave voluntarily or involuntarily during the vesting period. These conditions make LTIP shares a rather contingent reward.

LTIP share awards in the US take two primary forms, restricted stocks and multi-year bonus plans. The former have no performance criteria but vest with the passage of time. The unvested restricted stocks will be forfeited if managers leave the company (voluntarily or involuntarily) before the end of the vesting period (Bryan *et al*, 2000). Multi-year bonus plans contain performance thresholds as LTIP shares do in the UK. They also have the same leaving constraint as restricted stocks. Empirical US studies generally do not distinguish between these two forms and use the term 'restricted stocks' for both (Jensen and Murphy 1990; Bryan *et al*, 2000; Hall and Murphy, 2002; Jin, 2002; Coles *et al*, 2004).

Once vested, directors become the owner the LTIP shares although the shares may carry some restrictions regarding resale or transfer (Bryan *et al*, 2000). The value of LTIP shares varies according to their underlying stock prices. With an LTIP share, every dollar increase (or decrease) in the value of the firm stock will cause managerial wealth to increase (or decrease) by one dollar. Therefore the value of LTIP share is positively related to the value of the firm stock. This linear payoff structure is illustrated in Figure 2-1 where K is the firm stock price when directors first acquire LTIP shares, i.e., when the LTIP shares are vested and transferred to directors. The value change of LTIP shares thus totally depends on firm's stock price. Such a linear payoff structure provides incentive alignment between managers and shareholders. However, the negative side of the linear payoff is that there does not exist any floor to protect managers from the downside risk of investments. Managers' wealth is totally exposed to the risk of project returns, which increases managerial risk aversion (Smith and Stulz, 1985; Core *et al*, 2003). More discussion of this risk aversion effect can be found in Sections 2.3.3, 2.3.4 and 2.3.5.

Figure 2-1: Payoffs from LTIP shares



LTIPs can also be awarded in cash. LTIP cash awards ('LTIP cash' hereafter) are more like annual bonus with a vesting period for more than one year. Once a director achieves the performance target at the end of the vesting period, he is awarded the cash. The cash reward can also be spread over several years to match the multi-year performance targets. Unlike LTIP shares which have a linear payoff structure as discussed above, the value of LTIP cash does not vary with the value of the company's stock price once the LTIP cash is vested. Therefore, LTIP cash does not create a risk aversion effect on managers as LTIP shares do. LTIP cash is common in the US although not as popular as LTIP shares or stock options, but is very rare in the UK (Stathopoulos *et al*, 2005).

Although LITP shares may increase managerial risk aversion due to their linear payoff structure, Greenbury Report (1995) which provides the guidance on the structure of compensation packages in the UK, favours LTIP shares and calls for the substitution of executive stock option schemes by LTIPs because stock options are considered to encourage excessive managerial risk taking (see next section for a discussion). LTIP shares, which expose managers' wealth to the risk of companies' stock price fluctuation, can prevent managers from undertake excessive risk. While some argue that LTIP shares cause managerial risk aversion and others suggest that stock options bring managerial excessive risk taking, it is unclear which one can lead to optimal managerial risk-taking (Lee *et al*, 2004). One thing for sure is that this controversy depressed the executive stock option grants in the UK in the 1990s and made them less popular than in the US over the same period (see previous discussions about the levels of LTIPs and stock options in the UK and US in 1990s in Section 2.3.1).

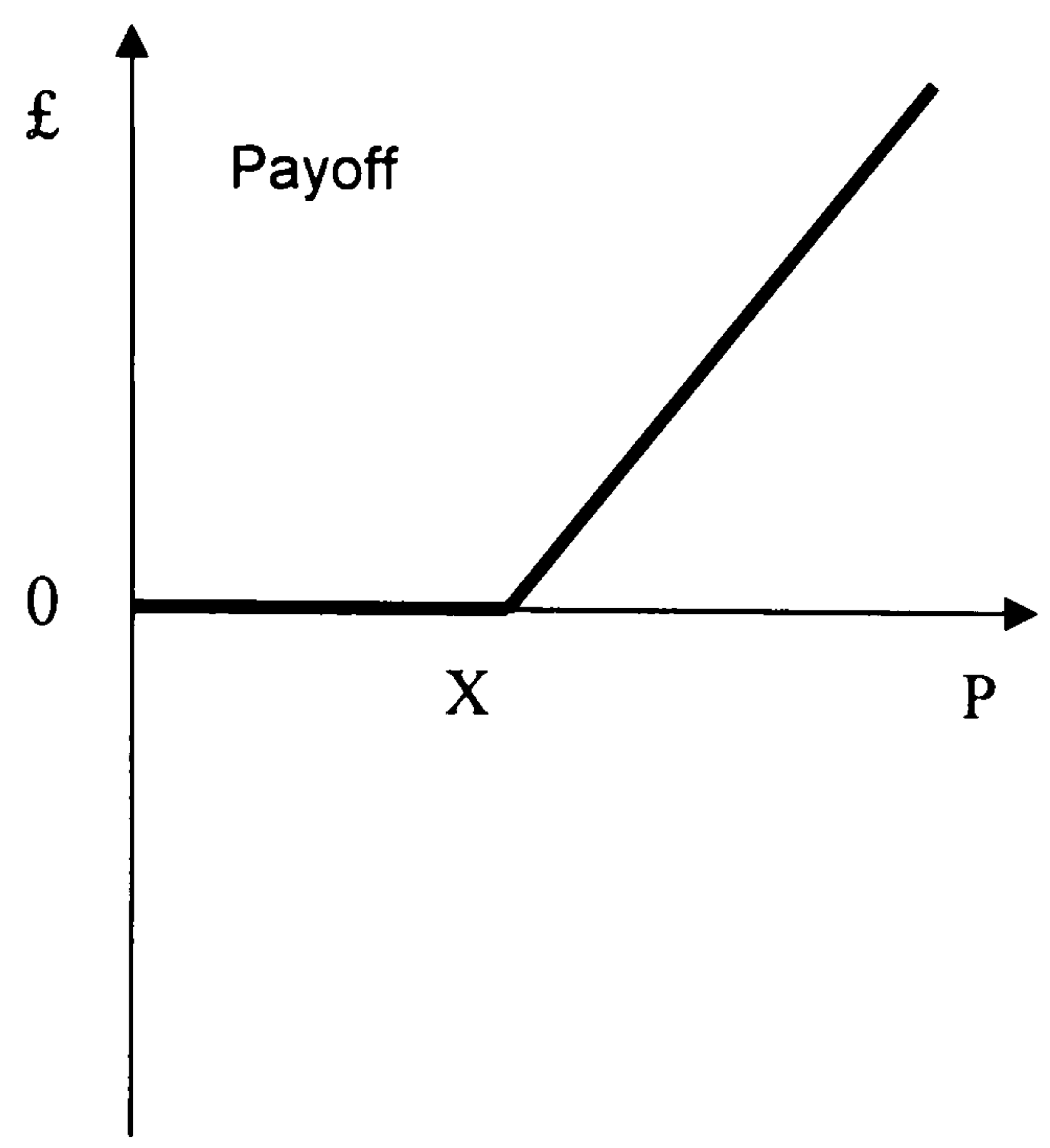
2.3.2.4 Stock options

The other type of long-term compensation schemes is stock options. A stock option is the right to purchase a stock at a pre-specified exercise price for a pre-specified term conditional on certain pre-determined performance benchmarks being achieved. In the UK, executive options have at least a 3-year vesting period starting from the option grant date before options can be exercised and they must be exercised within 10 years of issue or the options lapse (Conyon *et al*, 1995; Conyon and Murphy 2000; Stathopoulos *et al*, 2005). Just as with LTIP shares, stock options are subject to three major constraints, i.e., performance objective, vesting period, and leaving constraints. During the vesting period, directors are not awarded the stock options. Instead, they are awarded the right to obtain the options at the end of the vesting period. If they meet the performance objective at the end of the vesting period, they are awarded the options. Once vested, directors have to exercise the stock options within 10 years of the option grant dates. If a director leaves voluntarily or involuntarily during the vesting period, he will lose all the unvested stock options and may be forced to exercise unexercised but vested options before the expiry dates

The value of a stock option is a convex payoff function of its underlying stock price. For a stock option, if it is above the exercise price, a dollar increase (or decrease) in firm stock value increases (or decreases) managerial wealth by one dollar, i.e., linear slope effect, but if it is below the exercise price, a fall in the firm stock value does not reduce managerial wealth, i.e., convexity. The convex payoff structure of stock options is illustrated in Figure 2-2. The convex payoff structure of stock options insures managers against losses and can motivate managers to invest in high risk projects

(Smith and Stulz, 1985; Core *et al*, 2003). The following papers provide support for this inference.

Figure 2-2: Payoffs from stock options



P = stock price

X = exercise price

Smith and Stulz (1985) present a theoretical analysis of what determines corporate hedging behaviour. They define hedging as the acquisition of financial assets that reduce the variance of a firm's performance. A risk-averse manager uses hedging to diversify firm risk and consequently the risk to his own human capital and money invested in the firm. This however may not be in the best interests of shareholders, as it may reduce firm value. Smith and Stulz demonstrate that stock options, by making the manager's wealth a convex function of firm value, can transform the manager from a risk-avoider to a risk-seeker.

Core and Qian (2002) enhance Smith and Stulz (1985)'s conclusion. In their model, a CEO is reluctant to evaluate and adopt a project that is associated with a high degree of uncertainty. Stock options can motivate him not only to evaluate and adopt such a project but also to exert extra effort to manage the risk in the project in order to maximise firm value. This is achieved by the combination of the convexity and linear slope effect with stock options. The convexity protects the CEO from the project failure risk. The upside gains from the slope effect encourage the CEO to make the right project choice.

Nohel and Todd (2005) model a manager who has career concerns. The manager's ability is assumed to be evaluated by the managerial labour market via his firm's performance. His performance impacts the value of his future compensation and career development (i.e., the value of his human capital). The manager will not invest in a risky project for fear of putting the value of his firm and subsequently the value of his own human capital at risk. Their model suggests that the solution to such a problem is to provide the manager with call options whose convex payoff helps him to overcome his risk aversion and offers great potential rewards if a risky endeavour is pursued.

While the above authors state that stock options encourage managerial risk taking and should be promoted as a means of executive compensation, they also neglect to say that stock options can also encourage managers to seek excessive risk, i.e., indulge in inordinate gambles. Again this is because of the convex payoff structure of stock options, which provides a substantial reward for success but little downside risk if an investment fails. Since the dotcom/telecom/internet bubble burst in early 2000, a number of business journalists have criticised that excessive grants of stock options[27], particularly in the US, turned directors into speculators and induced them to indulge in excessively risky projects to push up the stock prices during the bubble period of the late 1990s (Roberts, 2002; Elson, 2003; Plender, 2003; Schneider, 2005). Together with seeking excessively risky projects, directors use all kinds of other methods such as 'cooking' the accounting books and engaging in takeovers to obscure the real economic picture of the firm and to boost the stock prices (Plender, 2003). In the case of Enron, directors exercised their options and sold their high-priced shares before the market realised that it was fooled by the 'option game' played by the directors. These activities substantially increased firms' bankruptcy risk with victims including Enron, Tyco, Worldcom, etc. Moody, the credit rating agency, researched 43 companies that had been rated B3 or higher but defaulted between 1993 and 2003 and found that 22 of these firms offered their CEOs much larger than expected stock option grants (Schneider, 2005). In their study expected level of stock option grants is measured against a company's size, past operating performance, industry conditions and long-term rating. Moody also investigated 214 companies that experienced downgrades of three or more rating notches within 12 months and found that the level of CEO stock option grants was higher than expected in 140 cases.

[27] Stock options were not treated as an expense in a company's account and did not need shareholders' permission to grant to managers. Therefore, stock options appeared to be a type of compensation contract that has a low cost but may provide an incentive for managers to improve firm stock price. This encouraged excessive grants of stock options in 1990s (Murphy, 2003). Since the dotcom bubble burst in early 2000, proposals to record stock options as an expense in a company's Profit & Loss account have been endorsed by leading investors like Warren Buffett, regulators, and a growing number of business journalists and academics.

Existing literature on stock option repricing also recognises the possibility that stock options can induce excessive managerial risk taking. Studies such as Roger (2005) state that deep out-of-money options, i.e., current stock prices much lower than the exercise price of stock options, can drive CEOs to engage in excessive risk taking to push up own firm stock prices. To illustrate, assume a CEO for whom 90% of his potential income associated with his company is from stock options. If the stock goes down to $10 and the CEO's options have an exercise price of $100, the stock options are likely to be worth nothing. Under this circumstance, the CEO may undertake excessively risky projects to try to drive the stock back up at any company costs, which can be disastrous for the company. To prevent this, companies need to reprice the exercise price of the deep out-of-money stock options, i.e., to reset an exercise price closer to the current stock price, to lessen the CEO's incentive toward inordinate gambles.

To sum up, the above literature argues that the convex payoffs of stock options, rewarding success but eliminating downside risk, can induce managers to take risky projects. It can also make managers indulge in excessive risk taking.

2.3.2.5 Managerial shareholdings

Just as with LTIP shares, managerial shareholdings have a linear payoff function. Their value is totally exposed to the variability of firm stock performance and therefore increases managerial risk aversion (Smith and Stulz, 1985; Core *et al*, 2003). More discussion about the risk aversion effect can be found in Sections 2.3.3, 2.3.4.2 and 2.4.1

2.3.2.6 Summary

Section 2.3.2 discusses the payoff structure of each component in managerial wealth portfolio, and the impact of the wealth components on managerial risk incentive. In summary, fixed compensation has a flat payoff function and therefore will not drive managers to take risky projects. Although annual bonus has a convex payoff structure, its performance criteria are short-term-based and thus stop managers from pursuing long-term risky investments. A high level of fixed pay and annual bonus can exacerbate managerial risk avoidance. Equity-based managerial wealth may better align the interests of managers and shareholders since it links managers' wealth to firm stock performance. Both LTIP shares and managerial shareholdings have a linear payoff structure that is more likely to increase managers' risk aversion than decrease it. As a result of their convex payoff function, stock options appear to be the only wealth component that encourages managerial risk seeking. Stock options may even encourage managers to seek excessive risk, i.e., indulge in inordinate gambles. Such excessive risk taking may lead to investment and financing decisions that are too speculative and end up destroying firm value.

To test above theoretical arguments, empirical literature has developed measures for managerial incentives provided by the wealth components. Those measures are discussed in the next section.

2.3.3 Measurement of managerial wealth incentives

This section focuses on the measurement of managerial risk incentives arising from various wealth components. The measurement problem is a common problem encountered in empirical studies.

While it is common for empirical studies to use the value of cash compensation as the measure for managerial incentive from cash pay (Lewellen *et al*, 1987; Bizjak *et al*, 1993; Coles *et al*, 2004), research on equity-based wealth has employed a variety of measures. Earlier measures include: 1) a dichotomous variable for presence or absence of compensation plans (DeFusco *et al*, 1990; Gaver and Gaver, 1993; Conyon and Freeman, 2002; Richardson and Waegelein, 2003); 2) the number of options held by directors (Tufano, 1996); 3) the value of compensation (Agrawal and Mandelker, 1987; Conyon and Murphy, 2000; Datta *et al*, 2001; Ryan and Wiggins, 2002). However, none of these measures fully captures managers' incentive to alter firm risk[28] (Core and Guay, 1999; Guay, 1999).

Since Jensen and Murphy (1990) and Yermack (1995), many financial researchers have measured managers' incentive from equity holdings as managers' fractional ownership of their firms, which is the sensitivity of mangers' equity-based wealth portfolio to *a dollar* change of firm value. This sensitivity is called 'delta'. A higher delta indicates a more sensitive relationship between managers' wealth and company stock performance, hence a better incentive from managers' equity holding. This approach is motivated by Jensen and Meckling (1976)'s agency model of the

[28] It is since 1992 the US Securities and Exchange Commission (SEC) began requiring firms to disclose detailed information on executive compensation in their proxy statement. Firms have to disclose executives' salary, bonus, stock options, restricted stock, etc (Bryan *et al*, 2000). In the UK, Greenbury (1995) and Hampel (1998) reports require disclosure of data comparable to those of available for US executives (Conyon and Murphy, 2000). Many earlier studies did not have detailed information available and were constrained by the data to measure stock option and restricted stock compensation in a simple way such as using a dichotomous variable for presence or absence of stock options, or using the number of stock options, thereby diminishing the power of the empirical test.

firm[29]. In this model, managers own less than 100% of the firm and only bear a fraction of the agency costs through ownership claims. Agency costs are mitigated when managers own a larger percentage of the firm. Therefore, fractional ownership is used to measure the incentive from mangers' equity holding.

To generate the delta for the whole managers' equity-based wealth portfolio, researchers first calculate the incentive from one unit of equity-based wealth, for instance one stock option, which is the dollar change of a stock option for *a dollar* change in the company stock price, i.e., *Option delta.* They then multiply managers' ownership of stock options as a percentage of the total outstanding ordinary shares by *Option delta* to generate the incentive of managers' portfolio of stock options. The same approach is used for the incentives from LTIP shares and managerial shareholding. The sum of the three incentives gives the total incentive from all of the managers' equity-based wealth components. This procedure is summarised in Equation 2-1.

$$\begin{aligned} \textit{EQUITY DELTA} &= \textit{LTIP shares held as \% of firm shares} * \textit{LTIP delta} \\ &\quad + \textit{Options}^{30} \textit{ held as \% of firm shares} * \textit{Option delta} \\ &\quad + \textit{Shares held as \% of firm shares} * \textit{Share delta} \end{aligned} \qquad \textbf{Equation 2-1}$$

where *LTIP delta, Option delta and Share delta* are all measured as the change of the value of one LTIP share, one stock option or one managerial share with regard to one dollar change in share price.

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29 See Section 2.2 for a discussion of the principal-agent conflict.

30 Shares covered by stock options.

The above approach ('JM' approach hereafter), however, is criticised by Hall and Liebman (1998) and Core and Guay (1999) as being not appropriate in reflecting managers' equity incentive. The assumption in the JM approach is that the incentive increases with a manager's fractional ownership of the firm. Hall and Liebman, and Core and Guay argue that when managers are risk averse, a large dollar holding of equity can have a powerful incentive even when the fractional share holding is small. It is common that modern large public companies have diffused share ownership. A manager generally does not hold a big percentage of company shares. However, a small proportion of share ownership can contain a large number of shares. In this case, a small fractional increase of the manager's shareholding can bring substantial increase in share numbers, which when multiplied by a high share price can lead to a large increase in a manager's dollar holding of firm equity. This can provide a strong incentive for managers to improve the share price.

Core and Guay (1999) suggest an approach to measure managerial equity incentive by the dollar change in the value of managers' equity holding for *a percentage change* in firm value. This approach assumes that the incentive offered by managers' equity holding increases with a manager's dollar ownership of the firm. Core and Guay redefine the delta for one LTIP share, one stock option and one managerial shareholding as the change in value of each of these wealth components based on a 1% change in stock price (see Section 6.2.1.2 for a discussion about how to calculate those deltas). Multiply the delta generated above by the amount of corresponding equity holdings gives the value of the delta for the portfolio of LTIP shares, stock options or managerial shareholding. The sum of these three deltas is the value of the equity delta (EQUITY DELTA) of a manger's equity holdings of his firm. Equity delta is formulated as:

$$EQUITY\ DELTA = Number\ of\ LTIP\ shares\ *\ LTIP\ delta$$
$$+Number\ of\ Options^{31}\ *Option\ delta \qquad \textbf{Equation 2-2}$$
$$+Number\ of\ Shares\ *\ Share\ delta$$

Whichever the approach is used to measure delta, delta still reflects the slope relationship between managerial wealth and firm stock performance. A high delta increases the expected payoff to managers, i.e., managers gain more by improving their companies' stock price when their equity holdings are more sensitive to firm stock performance. Therefore, managers have more incentive to engage in risk and positive NPV projects to improve firm value. However, a high delta also increases managers' risk exposure, i.e., managers lose more if their investments fail and pushes down the stock price. Researchers suggest that when exposed to too much risk, a manager may become overly risk-averse and forego profitable but risky projects. (Aggarwal and Samwick, 1999; Guay, 1999; Mishra *et al*, 2000; Jin, 2002; Coles *et al*, 2004). Therefore, a high slope of the wealth-performance relationship, i.e., a high delta, is likely to result in managerial risk aversion. The above discussion indicates that there may exist a nonlinear relationship between delta and managerial risk taking.

Smith and Stulz (1985) and Guay (1999) suggest that the convexity of the wealth-performance relationship helps a manager overcome his risk aversion and induce him to make risky investments. When a manager's wealth is structured as a convex function of firm stock performance, for instance by adding stock options into executive compensation, the manager' wealth is to some extent (depending on the magnitude of

[31] Shares covered by stock options.

the convexity) protected from the downside investment risk. The manager thus exhibits a more risk-seeking attitude than when his wealth is not a convex function of firm performance, i.e., no protection of his wealth from investment failure. Guay (1999) names the convexity 'vega', and measures it as the change of manager's wealth to the 1% change of stock price volatility. The calculation of the vega for a director's option holding can be made as follows. The vega for a stock option is first measured by the change of a stock option value to a 1% change of the underlying stock return volatility. The vega for the whole option portfolio is then generated by multiplying the total number of options by the vega for one stock option[32]. A high vega, indicating a close association between the director's wealth and his firm's stock return variability, will incentivise the director to undertake risky projects to increase firm risk.

The following sub-section presents the magnitude of delta and vega for different managerial wealth components reported by the empirical studies.

2.3.3.1 Magnitude of delta and vega for managerial wealth components

The delta and vega for fixed compensation and annual bonuses are negligible since neither of them is linked to firm stock price performance or volatility. Nevertheless, some empirical studies have examined their association with stock performance and proved that there is a weak connection. Using the Forbes sample of 2,213 US CEOs' compensation from 1974 to 1986, Jensen and Murphy (1990) find that

[32] The above illustration only assumes that the director holds one tranche of stock options, i.e., options with the same grant date, exercise price, and expiry date. In reality, directors hold more than one tranche of stock options. See Section 6.2.1.2 of Chapter 6 for a discussion about how to calculate option vega when directors have more than one tranche of options.

on average, each $1,000 change in shareholder wealth corresponds to an increase in the current and the next year's salary and bonus of only 2 cents. They conclude that this incentive is far too low to motivate managers to engaging in growth-oriented risky projects to improve firm performance. For a sample of 478 large US firms from 1980 to 1994, Hall and Leibman (1998) find that 10% change in a firm's market value of equity can only bring about $23, 400 increase its CEO's salary and bonus, 53 times less than the increase in the value of CEO stock options and stockholdings. These results again show that the pay-performance link provided by cash compensation is far to weak to incentivize managers to engage in growth-oriented risky projects. Given that there is no direct association between cash compensation and stock price volatility, none of the existing studies on executive compensation has reported a vega value for cash compensation.

As is the case with fixed compensation and annual bonus, delta and vega for LTIP cash compensation is difficult to calculate because the value of LTIP cash does not vary according to stock price (see Section 2.3.2.3 for a discussion on the payoff structure of LTIP cash). My literature review shows that there have been no empirical studies that examine the relationship between performance and LTIP cash. This is possibly because, as stated by Stathopoulos *et al* (2005), LTIP cash is less common than the other compensation components and it is very rare in the UK.

It is, however, straightforward to calculate the delta for a managerial shareholding because whatever the change of the stock price, its value will change for the same amount (see the previous section). This means that a share held by a manager has a delta of 1. As discussed in Section 2.3.1, managerial shareholding is the major part of managers' equity-based wealth portfolio. Researchers have shown that managerial shareholding contributes substantially to managerial risk incentive provided by total equity holdings. Using compensation data for 278 US corporate CEOs on 31 December 1993, Guay (1999) find that for 1% change in stock prices, managerial shareholdings on average change \$251,995 (see Equation 2-2 for their approach to calculate delta for managerial shareholdings). In contrast, the value of stock option holdings only changes \$72,169 for the same percentage stock price change. The change could be even smaller for LTIP shares[33].

Although an LTIP share has a linear payoff structure in like manner to managerial shareholding, the delta for the former could vary between 0 and 1 due to its contingent nature. Its value depends on the probability that managers will remain employed long enough for all time-related restrictions to lapse and the probability that they will pass all the performance thresholds (see the previous section for a more detailed discussion). This is by no means known before these events happen. Therefore, for simplicity, empirical studies generally assume a delta value of 1 (i.e., independent of all contingencies) (Bryan *et al*, 2000; Conyon and Murphy, 2000; Conyon and Sadler, 2001; Rogers, 2002; Coles *et al*, 2004). Bryan *et al* (2000) report that from 1992 to 1997 the CEO's LTIP shares changed on average around 14 cents for a \$1,000 change in the market value of their firms' equity.

[33] Guay does not report the LTIP delta but he addresses that LTIP shares are much less significant than options and managerial shareholdings. For example, the average value of LTIP shares is \$0.97 million for their sample, while it is \$4.23 million and \$24.23 million for stock options and managerial shareholdings separately.

Option delta for one stock option also varies between 0 and 1 depending on the moneyness[34] of a stock option. Jenson and Murphy (1990) find that a $1,000 change in shareholder wealth corresponded to just a 15 cents change in CEO option holdings from 1974 to 1986. Yermack (1995) reports a 59 cents change based on data from a sample of 792 US public firms from 1984 to 1991, a value nearly four times higher than that documented by Jensen and Murphy. Bryan *et al* (2000) report the even higher value of $1.8 from 1992 to 1997 for a total sample of 1788 firms listed in New York Stock Exchange, NASTAQ and American Stock Exchange. All of the three papers follow Jensen and Murphy's approach (see Equation 2-1) to calculate delta. Guay (1999) and Rajgopal and Shevlin (2002) follow Core and Guay (1999)'s approach (see Equation 2-2) to calculate delta. They also find that the change of stock price can have a great effect on CEOs holdings of their companies' stock options. Guay reports that CEO option holdings on average change $72,169 for 1% change in stock price and the median change is $36,407. For a sample of 117 CEOs of firms in oil & gas industries over 1993-1997, Rajgopal and Shevlin (2002) document a mean change of $58,670 and a median change of $28,040 for a 1% change in companies' stock price. The increase of delta value for the managerial stock option portfolio is mainly due to growing

[34] Moneyness refers to the relationship between the current market price and the exercise price of a stock option. If the stock price is higher than the exercise price, the option is in-the-money; if they are equal, the option is at-the-money; if the stock price is lower than the exercise, the option is out-of-the-money. The value of option delta increases as the stock option changes from out-of-the-money to in-the-money. The delta of an out-of-the-money option approaches 0; the delta of an at-the-money option approaches 0.5 and a delta of in-the-money option approaches 1 (Hull, 2000, Chapter 13).

popularity of stock options in executive compensation in 1990s (see Section 2.3.1 for statistics about the growth of stock options since 1980s in the US and UK).

The sum of all three deltas, i.e., LTIP share delta, managerial shareholding delta and stock option delta, reflects the aggregate managerial incentive arising from all forms of equity claims (Jensen and Murphy, 1990; Core and Guay, 1999; Guay, 1999). Core and Guay (1999) argue that the explanatory power of an incentive proxied by all equity-based wealth is higher than one proxied only by managerial shareholding. Hall and Leibman (1998) find that a 10% increase in firm value increased the value of median CEO's stock and stock options by about \$1.25 million. For 5,352 CEO-year observations from 1992 to 1996, Core and Guay (1999) report that the mean change in CEO equity claims for a 1% change in stock price is \$558,000 and the median value is \$117,000. Guay (1999) reports a mean of \$324,164 and a median value of \$38,784 for 1% change of stock price. The mean value reported by Rajgopal and Shevlin (2002) is \$155,890 and the median value is \$89,150. Coles *et al* (2004) use a large sample of 10,687 firms from S&P's ExecuCom database and report a mean delta of \$599,609 and a median delta of \$206,359 for CEOs over the period of 1992-2002. These US studies suggest that during the 1990's the value CEOs' equity holding was highly sensitive to firm stock price performance.

Conyon and Murphy (2000) find that the equity delta for UK CEOs is much less than that for US CEOs. Based on a sample of the 510 largest (by market capitalisation) UK firms and 1,666 US firms from the S&P indices in 1997 and using Jensen and Murphy's approach to calculate delta (see Equation 2-1), they report that a £1,000 change in shareholder wealth will bring an average change of £23.3 and a median change of £2.5 to CEOs' wealth, while a \$1,000 change in shareholder wealth will bring an average change of $41.8 and a mean change of $14.8 to the wealth of the CEOs in the US. Therefore, it appears that UK CEOs have significantly lower pay-performance sensitivity than their US counterparts. This is not surprising given that the level of equity holdings of UK CEOs is much lower than that of US CEOs (see Section 2.3.1 for evidence).

As discussed in the last section, although a high delta increases the association between managers' wealth and firm performance, it also enhances managers' risk aversion because managers' equity claims are now at higher risk. While Coles *et al* (2004) examine US data and do find some evidence that high equity delta causes managerial risk aversion (see Section 2.3.4.2), it is still interesting to explore UK cases.

Vega, the sensitivity of a manager's wealth to his company's stock return volatility, is zero for incentive schemes whose payoffs are a linear function of firm stock performance (Guay, 1999). This is because the change in the distribution of firm stock performance does not affect the expected value of those incentive schemes. Therefore, vega for managerial shareholdings is zero. Nevertheless, Guay (1999) calculates a value for managerial shareholding vega by subscribing to the view of Jensen and Meckling (1976) that stock ownership can be viewed as a call option on the underlying firm value. Still, he finds this vega of little economic importance. The median change in the value of CEOs' common stockholdings for 1% change in stock return volatility is only $2.2, indicating that if CEOs exert extra efforts to increase their firm stock return volatility by 1%, the CEOs are only rewarded by $2.2 increase in their managerial holdings. By contrast, their stock option holdings can increase by approximately $30,000 for the same amount of change in stock return volatility.

Therefore, Guay concludes that vega of managerial shareholdings is of little economic importance.

Drawing on the Guay (1999) conclusion and the fact that there is no straightforward approach to calculate vega for managerial shareholdings, empirical studies generally focus on option vega (Rajgopal and Shevlin, 2002; Coles *et al*, 2004). Rajgopal and Shevlin (2002) report a median option vega of $17,660, lower than the vega value reported by Guay (1999) but still suggesting that CEOs can make their option holdings worth $17,660 more by only increasing the stock return volatility of their firms by only 1%. The vega values reported by both Guay (1999) and Rajgopal and Shevlin (2002) indicate that stock options are a powerful mechanism by which managers can be incentivised to take more risk.

Just as it is difficult to estimate the delta for an LTIP share, it is also difficult to calculate its vega value due to the contingent nature of LTIP shares. As discussed earlier in this section, the value of an LTIP share depends on the probability that managers will remain employed long enough for all time-related restrictions to lapse and the probability that managers pass all the performance thresholds. This is by no means known beforehand. Empirical studies generally ignore all of these contingencies when estimating the delta for LITP shares. Similarly, empirical studies generally assume 0 for LTIP share vega (Rajgopal and Shevlin, 2002; Coles *et al*, 2004).

2.3.3.2 Summary

Empirical studies generally use the change of managers' wealth to the change of firm stock performance, i.e., delta, and the change of managers' wealth to the change of firm stock return volatility, i.e., vega, to measure the incentives provided by managerial equity-based wealth. While vega directly reflects the association between managers' equity holdings and firm risk, the risk incentive effect from delta is not as straightforward as vega. Delta can offer both risk preference and risk avoidance incentives depending on the level of delta. Empirical studies show that delta and vega in the US in the 1990s rose to historically high levels. The delta reported for UK CEOs appears to be significantly lower than those of their US counterparts. There are no prior studies that investigate vega value for the wealth of UK managers.

2.3.4 Empirical evidence

Section 2.3.2 presents theoretical arguments for risk incentives provided by various managerial wealth components as a result of their different payoff structures. The measures for those incentives are discussed in Section 2.3.3. This section outlines the empirical findings on how the components of managerial wealth incentivise managers to pursue higher risk investment projects. Section 2.3.4.1 focuses on fixed compensation and annual bonus and Section 2.3.4.2 focuses on equity-based wealth such as LTIP shares, stock options and managerial shareholdings. There are currently no separate empirical studies on the relationship between managerial risk taking or firm performance and LTIP cash. Therefore there is no a separate section for LTIP cash.

Empirical evidence on the impact of managerial wealth on managerial risk taking is limited (Williams and Rao, 2000; Rajgopal and Shevlin, 2002; Coles *et al*, 2004). There are even fewer studies examining both managerial risk taking and subsequent firm performance. This is because studies in the traditional agency domain simply assume that managers are risk avoiders and their risk-seeking behaviour will reduce agency costs for the firm and consequently improve firm performance. This risk assumption and the risk-related agency problem have been discussed in Section 2.2.

2.3.4.1 Fixed compensation and annual bonus

Consistent with theoretical arguments, empirical studies show that fixed compensation and annual bonus have few alignment effects on the agency conflicts between managers and shareholders. Coles *et al* (2004) provide one of the few sets of direct empirical evidence of the impact of cash compensation on managerial risk taking. They examine the relationship between managerial wealth and firm policies that increase firm risk profile. R&D expenditures are riskier investments than capital expenditures on tangible assets such as property, plan and equipment. One way for managers to increase firm risk is to reallocate investment funds away from those tangible assets toward intangible assets such as R&D. Another way that managers can increase firm risk is to reduce the level of diversification of their firms and to focus on firm core competence. Managers can also increase firm leverage to increase firm risk. Based on a sample of 1,500 firms over the period 1992-2002, Coles *et at* find evidence that cash compensation is negatively related to R&D investment and positively related to capital expenditure on tangible assets. They also find that cash pay is positively related to firm diversification and the reduction of firm leverage ratio. Therefore, they conclude that cash compensation can increase managerial risk aversion.

Some other studies which although do not demonstrate a direct causal relationship between cash compensation and managerial risk taking, they do show that cash compensation and firm risk are connected. Lewellen *et al* (1987) perform a study using the five highest-paid executives of 49 large corporations over the period 1964 to 1973. They find that salary and bonus are significantly negatively related to firm risk as measured by the variance of 60 monthly stock returns prior to the year each executive's pay is examined. For a sample of 430 CEOs of large US firms from 1975 to 1989, Bizjak *et al*, (1993) document that salary and bonus (as a percentage of total pay) decline with growth opportunities measured as firm market value to book value of assets, and as the ratio of R&D expenditure to total assets. Growth opportunities are associated with greater firm risk (Smith and Watts, 1992), and from the above it appears that cash compensation is negatively related to firm risk.

2.3.4.2 Equity-based managerial wealth components

This section first outlines empirical studies in the existing literature regarding equity-based compensation as a whole and then subsequent subsections discuss each component separately.

Agrawal and Mandelker (1987) examine how managers' equity holdings affect managers' investment and financing decisions to increase firm risk. Firm risk is measured by changes in the variability of returns on the firm's assets following acquisitions or selloffs, and by changes in debt-equity ratio. Following the Black and Scholes (1973) option pricing model that an increase of firm risk can increase the value of firm's common stock[35], Agrawal and Mandelker expect that when managers hold common stocks and options in their firms, they are likely to make a risky investment to increase the value of their equity holdings. Agrawal and Mandelker also expect that managers may increase firm's leverage ratio, i.e., debt-equity ratio, through acquisitions

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[35] Black and Scholes (1973) observe that equity can be regarded as a call option on the firm value with the exercise price equal to the level of debt in the firm. While the price of this option increases with the firm value, the option price is bounded from below by zero. Importantly, the value of this call option (equity position) will increase with the variance or risk of the firm. Managers who are more aligned with shareholders through an equity ownership will undertake decisions which increase the risk of the firm. In fact, as the risk increases, wealth is transferred from debt holders to stockholders.

or selloffs to increase firm risk and, consequently, the value of their equity holdings. Agrawal and Mandelker measure managers' equity holdings by the value of stock and options holdings deflated by total annual compensation. They use a simplified Black-Scholes (1973) model to value stock options. For a sample of 153 acquisitions and 294 selloffs over 1974 to 1982, they find that managerial equity holdings in firms for which the return variance increases upon an investment announcement are larger than for firms for which it decreases. They also find that equity holdings of managers of firms with a debt-equity ratio that increases around the announcement of the acquisitions or selloffs are larger than those for which this ratio decreases. Therefore, they conclude that managerial equity-based wealth can enhance managerial risk taking. This risk-seeking effect outweighs the risk aversion effect carried by equity holdings due to wealth nondiversification (see Section 2.4 for a discussion of the risk aversion effect of equity holdings).

As discussed in Section 2.3.3, a measure of managerial wealth incentive represented by the value of compensation contracts does not fully capture managers' incentive to alter firm risk. Therefore, the conclusion by Agrawal and Mandelker (1987) is questionable because they use an inappropriate measure for the incentive provided by managerial equity holdings. In addition, when Agrawal and Mandelker change the measure of managerial equity holdings from the value of equity holdings deflated by total annual compensation to the value of equity holdings deflated by cash compensation, the result also changes. They no longer find that managerial equity holdings have any impact on the change of firm risk profile. Therefore, it seems that the conclusion regarding the impact of managerial equity-based wealth depends on the measures employed to make the assessment. As discussed in the previous sections, the sensitivity of managerial wealth to firm performance, i.e., delta or the sensitivity of managerial wealth to the change of firm risk, i.e., vega, appear to be more appropriate measures for managerial risk incentive. Those measures have been employed in some recent empirical studies to examine the relationship between firm investment risk and managerial equity-based wealth.

In addition to analysing the relationship between managers' choices of firm policies that increase firm risk and managers' cash compensation (see Section 2.3.4.1), Coles *et al* (2004) also examine how equity delta affects managers' decisions regarding firm policies that increase firm risk including higher R&D investments, reduced capital expenditure on tangible assets, more focus on firm core competencies (i.e., less firm diversification), and higher firm leverage. They expect that delta can have mixed effects on managerial risk taking. On one hand, a high delta can increase managerial risk seeking because managers need to take risky and positive NPV projects to enhance firm value and consequently the value of their equity holdings. On the other hand, a higher delta exposes managers' wealth to more risk because managers' wealth is more closely linked to the fluctuation of firm stock price. Managers therefore could choose less risky projects. Coles *et al* (2004) report mixed results for the relationship between managerial risk taking and equity delta. Some of their models disclose a negative association while others indicate a positive or a statistically insignificant result. Therefore, it is not clear what effect an equity delta has on managerial risk incentive. This is an interesting area worth further investigation.

Rogers (2002) investigates the degree to which the incentive from CEO's options and shareholdings is related to the corporate interest rate or foreign currency derivative usage, i.e., a hedging strategy. Hedging is used to achieve the reduction of firm risk, in this case, arising from the fluctuation of interest rates or foreign exchange rates. So if equity delta increases managerial risk taking, it should discourage corporate hedging. Otherwise, it should encourage managers' hedging behaviour. Rogers' sample consists of 569 randomly selected US firms whose accounting year ended between December 15, 1994 through to October 31, 1995, and which disclosed the notional value of their derivative holdings. Rogers does not find a significant relationship between the degree of derivative hedging and equity delta. Therefore, it is unclear whether equity delta drives managerial risk seeking or risk avoidance.

The above studies try to demonstrate a cause-effect relationship between equity delta and managerial risk taking, but they fail to do so. Interestingly, Coles *et al* (2004) imply a nonlinear concave relationship between equity delta and managerial risk taking. That is, a low equity delta encourages managerial risk taking. But when equity delta grows higher, it can induce managerial risk aversion. This is consistent with the argument addressed in Section 2.3.3. If the effect of equity delta is concave, it is not surprising that the above studies do not find any significant results because they only assume a linear relationship between equity delta and managerial risk taking in their models.

The nonlinear effect of equity delta is also addressed by Mishra *et al* (2000) in their study of the effect of equity delta on firm performance. Mishra *et* al argue that a low delta can improve firm performance because it links managers' wealth with company stock price. However, a high delta, particularly in high-risk firms can be counterproductive because they expose managers' wealth to too much risk and cause them to take projects to reduce firm risk. Those risk reduction projects can destroy shareholder value. Mishra *et al* use a squared delta to capture the concave relationship.

Using the sample from Jensen and Murphy (1990), Mishra *et al* find the coefficient for delta is positive (significant at the 5% level) and the coefficient for $delta^2$ is negative (significant at the 5% level) in the regression of firm performance measured by industry-adjusted return on equity. Mishra *et al*'s result in effect supports the argument above suggesting the concave effect of equity delta on managerial risk taking.

There are more empirical studies that separately examine the delta of LTIP shares, stock options or managerial shareholdings. They are discussed in the following subsections. Existing studies generally only consider option vega when calculating vega for equity-based wealth because vega value for LTIP shares and managerial shareholdings are assumed to be zero (see the previous section for the explanation). These studies are also discussed below.

LTIP shares

To my knowledge, there has been no empirical study examining the effect of LTIP share delta on managerial risk taking. Ryan and Wiggins (2002) and Richardson and Waegelein (2003) use different measures of LTIP shares (or restricted stocks) [36] to examine its impact on managers investment decisions. Their conclusions however are mixed.

Ryan and Wiggins (2002) investigate the impact of restricted stocks on managers' decisions regarding R&D investments. R&D investments are long-term and are associated with a high degree of uncertainty. Restricted stocks have linear payoffs, which expose managers' wealth to downside firm investment risk. Ryan and Wiggins therefore hypothesize that restricted stocks could negatively influence R&D

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[36] LTIP shares are called restricted stocks in the US (see Section 2.3.2.2)

investments. They measure restricted stock incentive as the dollar value of restricted stocks (provided by S&P ExecuComp database) deflated by total annual compensation. Based on a sample of 1,088 Stand & Poor's firms in 1997, Ryan and Wiggins (2002) find that the value of restricted stocks as a percentage of CEO total compensation is significantly (at the 1% level) negatively related to R&D investments.

Richardson and Waegelein (2003) also examine the effect of LTIP shares on firms' R&D investments. They argue that LTIP shares can lengthen managers' investment horizons to multi-years to match the vesting period of LTIP shares. Therefore, managers can invest in some long-term and risky projects such as R&D. They examine the change of firms' R&D expenditure following the adoption of an LTIP share plan. For a sample of 134 US firms that adopted LTIP share plans from 1979 to 1999, Ryan and Wiggins find that firms' R&D intensity (R&D expenditure deflated by assets) significantly increased four years after the adoption of the plan as compared to the R&D intensity one year before the adoption. The result suggests that LTIP shares do increase managerial risk taking.

The above studies draw opposite conclusions with regard to the effect of LTIP shares on managerial risk taking. Moreover, neither of the studies use LTIP share delta to measure the risk incentive. As discussed in Section 2.3.3, measures that do not take managers' wealth sensitivity to the change of firm value into account do not capture managers' incentive to alter firm risk. More studies on the risk incentive effect of LTIP shares therefore are needed.

Stock options

There is more consensus regarding the positive risk-taking incentive arising from stock options. Core *et al* (2004) conduct a thorough literature review on equity compensation and managerial incentives. They conclude that the convexity embedded within stock options can make managers select projects that increase firm risk.

Guay (1999) explores the relationship between firm's risk level and the vega of stock options held by its CEO. Firm risk level is proxied by stock return volatility over 240 trading days around the compensation measurement date, a window of (-120, +120). The event date, i.e. the compensation measurement date, is 31 December, 1993. Guay finds that the vega of stock options significantly positively contributes to firm risk. This result is robust after controlling for variables that affect stock return volatility such as growth opportunities and after using an alternative measure of firm risk by estimating the stock return volatility over different time periods such as (+1, +120) and (+1, +240).

Williams and Rao (2000) investigate the relationship between firm risk taking and stock options using two different methods. The first method is to examine the influence of CEO stock option holdings on risk profile changes associated with corporate mergers. The second approach investigates the relationship between firm risk level and CEO stock option holdings based on a broader range of cross-sectional firms. For both approaches, Williams and Rao use two proxies for the risk incentive driven by stock options ('option incentive' hereafter): vega adjusted by firm assets and stock option value adjusted by firm assets.

In the first method, Williams and Rao's merger sample consists of 127 mergers between 1994 and 1996. Firm risk profile change throughout the period of a merger is measured in two ways. The first is the market-adjusted change of the variance of acquirer stock returns over an event window of (+11, +180) days after the completion date of the mergers to the event window of (-180, -30) days before the announcement date of the mergers. The second measure is the acquirer' leverage change from before an acquisition to after an acquisition. Both variance increasing and leverage-increasing mergers are considered as enhancing the acquirer's risk profile. CEOs' option holdings are based on their holdings prior to acquisition announcement. Williams and Rao find that for NASDAQ-listed acquirers, variance-increasing and leverage-increasing mergers are associated with greater CEO option incentive whichever way the option incentive is measured, by vega or option value. Nevertheless, they do find that vega as a measure has a stronger explanatory power than option value as a proxy.

In the second approach, Williams and Rao's cross-sectional sample consists of 1,225 firms from S&P 500, S&P 400 Mid Cap and S&P Small Cap for 1993 and 1995. Firms' stock return volatility is regressed against option incentive after controlling for firm size and leverage. Williams and Rao again find that option incentive is significantly associated with increased corporate risk taking particularly for NASDAQ-listed firms. Summarising the two sets of analyses, the authors conclude that stock options, as a result of the embedded convexity, are useful in aligning the risk preferences between CEOs and shareholders.

Rajgopal and Shevlin (2002) investigate the influence of stock options on actions that CEOs of oil and gas firms take to manage the risk of uncertain success in exploring for new oil and gas reserves. They hypothesize that if stock options mitigate the risk-related incentive problem by motivating managers to make high-risk investments, there should be a positive association between option vega and the riskiness of exploration activities as measured by the variation in future cash flows from exploration activity. For a sample of 121 CEO-year observations from 1992 to1997 in the US oil and gas industry, they find a significantly (at the 1% level) positive relationship between the level of *ex post* exploration risk taken by the firm and option vega. In addition, they discover that vega is negatively (significant at the 1% level) associated with the extent of oil price hedging designed to reduce firm risk exposure. The coefficient is significant at the 1% level. Overall, they conclude that stock options incentivise CEOs in oil & gas firms to take on riskier exploration projects aimed at increasing firm risk, and make CEOs reduce the hedging of oil & gas risk exposure.

Coles *et al* (2004) find that vega of CEO option holdings is significantly positively related to R&D intensity and significantly negatively related to capital expenditure on tangible assets. This implies that CEOs with a higher vega allocate investment dollars away from less risky capital expenditure on tangible assets such as property, plant and equipment towards more risky investments on R&D and other intangible assets. Moreover, they report that vega is significantly positively related to firm focus (i.e. less firm diversification) as measured in two different ways: the Herfindahl index of concentration of sales across various business segments, and the logarithm of the number of reported business segments. Thirdly, they discover that vega is significantly positively related to firm leverage even after controlling for other determinants of firm leverage, such as R&D, Z-Score[37], etc. See Section 2.3.4.1 for a discussion of how R&D investments, capital investments on tangible assets, firm focus

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[37] In the 1960's, Edward Altman using Multiple Discriminant Analysis combined a set of five financial ratios to come up with the Altman Z-Score (Altman, 1968). This score is used to predict a company's probability of failure. The Altman Z-Score uses eight variables from a company's financial statements to generate the financial ratios: earnings before interest & tax, total assets, net sales, market value of equity, total liabilities, current assets, current liabilities, retained earnings. Coles *et al* (2004) use Altman (1968)'s approach to calculate Z-Score.

and firm leverage are related to firm risk. In summary, Coles *et al* demonstrate that stock option vega provides an incentive for CEOs to adopt firm policies that increase company risk.

Section 2.3.3 has introduced measures other than vega for the risk incentive from stock options in the existing literature. Studies employing those measures generally show that stock options encourage managerial risk taking. By examining 641 instances of firms' voting on stock option plans from 1978 to 1982, Defusco *et al* (1990) find that the variance of a firm's stock returns increases 2 years following the approval of an executive stock option plan as compared to the stock variance 2 years before the announcement. They conclude that stock options induce executives to undertake more investments that increase a firm's risk profile. Ryan and Wiggins (2002) find that the value of stock options deflated by CEOs' annual compensation significantly positively affects firms' R&D intensity. Tufano (1996) examines the corporate risk management practice in the gold mining industry. Given that the output of such an industry is a globally traded and volatile commodity, firms in this industry are considered to have high risk profiles. By investigating 48 North American Mining firms from 1990-1993, he finds that management teams that hold more options tend to conduct less hedging against gold price risk.

Datta *et al* (2001) conduct an analysis of firm risk taking within the context of corporate acquisitions. For a sample of 1,719 completed acquisitions during the period 1993 to 1998, they report that acquirers with a higher level of stock options granted to their top five executives in the year prior to acquisition announcement buy targets with higher growth opportunities as proxied by targets' book-to-market ratio. In addition, Datta *et al* find that the change of the standard deviation of companies' daily stock returns at (+11, +70) days period over (-120, -60) days period (day 0 is the effective date) is also significantly higher for acquirers with a higher level of stock options, even after controlling for the acquirers' leverage change around the acquisitions. Therefore, Datta *et al* conclude that stock options encourage corporate executives to undertake riskier acquisitions.

Moreover, they discover that these riskier acquisitions do not underperform their benchmarks (i.e., size, book-to-market, and momentum matched firms) 3 years after acquisitions, whereas less risky acquisitions on average do underperform their benchmark firms by –28.91% (median –22.78%) over the same period. Both values are significant at the 1% level. Collectively, these results imply that stock options are effective in shaping long-term corporate investment policies and encourage managers to make decisions more closely aligned to the interests of shareholders.

Roger (2002), however, does not find that option vega has any significant impact on corporate hedging, indicating that stock options have no impact on managerial risk taking. Roger's paper has been discussed earlier in this section.

Overall, the above studies examine the impact of stock options on firm risk investment, i.e., William and Rao (2000), Ryan and Wiggins (2002) and Datta *et al* (2001) and Coles *et al* (2004), also risk management, i.e., Tufano (1996), Rajgopal and Shevlin (2002) and Roger (2002), and firm risk level, i.e., Defusco *et al* (1990), Guay (1999), William and Rao (2000) and Datta *et al* (2001). These studies generally show that stock options encourage managerial risk taking due to the convexity in the payoff structure of stock options.

Managerial shareholdings

While there are a substantial number of empirical studies on managerial shareholdings, the number of studies that deal with the impact of equity ownership on managerial risk taking is limited, and the evidence presented is mixed.

Both Agrawal and Mandelker (1987) and Chen and Steiner (1999) argue that managerial shareholdings have a positive impact on firm risk. They employ Black and Scholes (1973) argument that equity can be regarded as a call option. The value of the call option, i.e., equity, increases with the firm risk. Managers who hold company shares, would like to increase firm risk so as to increase their share value. For a sample of 153 acquisitions from 1974 to 1982, and 294 selloffs over the same period, Agrawal and Mandelker (1987) do not find consistent evidence that managerial shareholdings contribute to the risk profile change in an acquiring firm, or in a divesting firm around the period in which a merger decision or a selloff decision is announced. Chen and Steiner (1999) however, report a significantly positive (significant at the 1% level) impact of equity holdings on firm risk as measured by the natural logarithm of the standard deviation of daily stock returns from 1991 to 1993. Their sample consists of 785 firms listed on New York Stock Exchange.

Hill and Snell (1988) argue that increased managerial ownership aligns the interests of managers and shareholders. Managers will then adopt corporate strategies which meet shareholder interests, such as more corporate innovation and less corporate diversification. Corporate innovation is considered as firm risk enhancing and corporate diversification contributes to firm risk reduction. They use R&D intensity to measure firm innovation and firm industry sectors to measure firm level of diversification. For a sample of 94 firms from the Fortune 500 list, they find that a nigher managerial ownership contributes to less firm diversification but that managerial ownership does not have significant impact on firm innovation level.

Some studies, however, show that managerial shareholdings have negative impact on managerial risk taking. Ryan and Wiggins (2002) argue that the linear payoffs of managerial shareholdings, exposing managerial wealth to the downside investment risk, induce managerial risk aversion. They find that CEO shareholdings significantly negatively affect firm's R&D investment. Some studies suggest that the risk aversion effect of high managerial shareholdings comes from the nondiversification of managerial wealth portfolios, i.e., managers have a personal portfolio which is undiversified due to their commitments of human and financial capital in one firm. Managers would therefore conduct projects to reduce firm risk so as to diversify the personal wealth risk associated with their firms. Tufano (1996) finds that in gold mining firms, management teams which have a higher level of managerial shareholdings conduct more corporate hedging to reduce gold price risk.

Wright *et al* (1996) incorporate both the interest alignment and the wealth nondiversification arguments, and argue that the relationship between firm risk and managerial ownership is concave. Wright *et al* (1996) state at a low level of share ownership, managers would like to carry out risky and positive NPV projects to increase firm value and consequently their own wealth. A high level of managerial shareholdings will cause managers to have nondiversified wealth portfolios, managers therefore are more likely to undertake projects that reduce firm risk. This can be facilitated by the power given by the high equity ownership which gives managers more voting rights, i.e., the chance of getting entrenched (Morck *et al*, 1988; Stulz, 1988; McConnell and Servaes, 1990). The wealth nondiversification argument and empirical results are discussed in more detail in Section 2.4. Briefly, Wright *et al* (1996) prove that the relationship between managerial shareholdings and firm risk taking is concave.

2.3.5 Summary

Exiting literature only contains a limited number of empirical studies on the relationship between managerial risk taking and the components of managerial wealth. Overall, these studies suggest that fixed compensation and annual bonus provide few risk incentives for managers. However, those studies do suggest that equity-based wealth encourages firm risk taking. This seems mainly attributed to the convexity of stock options. There are no consistent results regarding LTIP shares and managerial shareholdings. Empirical studies also suggest that the impact of equity delta or managerial shareholdings on managerial risk taking is nonlinear. The next section provides further explanations for this nonlinear relationship.

2.4 Managerial wealth and managerial risk avoidance

Section 2.3 presents the schools of thought which argue that managerial wealth components can be structured in a way that will reduce the divergence of interests between managers and shareholders for firm-specific risk. This section provides two arguments together with the supporting empirical evidence that concentration of managerial wealth portfolios may intensify managerial risk avoidance.

2.4.1 Non-diversified managerial wealth portfolios

Some studies argue that compensation plans can only intensify the concentration of managers' wealth in their own firms and consequently reduce their tolerance to additional firm risk. Marcus (1982) models the impact of the profit-sharing characteristics of managerial compensation on firm risk behaviour. When monitoring is costly and managerial effort is discretionary, shareholders impose a binding constraint on managers' wealth diversification decisions, such as restricted stocks that must be held until the end of the vesting period to make sure managers can invest in long-term projects to enhance firm value. Such a binding constraint however, will lead managers to underinvest in risky projects and to spend excessive amounts of corporate resources on activities which reduce variability in firm profits, such as conglomerate diversification. This seemingly suboptimal behaviour thus induced is in fact optimal from managers' point of view given the constraint imposed.

Another consequence of not being able to hedge their wealth portfolio is that managers substantially discount the value of their performance pay. Lambert *et al* (1991) develop a model for assessing the value of a compensation contract from a manager's perspective. The model demonstrates that when the risk aversion parameter for the manager is 4.0 (the most risk-averse level in his illustration), 10,000 call options are valued by the manager at $189,400 if 10% of his other wealth is tied to the firm's stock price, but only $47,700 if 90% are. Following Lambert *et al* (1991), Meulbroek (2001), Hall and Murphy (2002), and Tian (2004) all develop theoretical models to estimate the difference between the market value of stock options (estimated using the Black and Scholes (1973) formula) and option value considered by managers. Consistent with the argument of Lambert *et al* (1991), these studies conclude that it is normal for managers to value their option holdings less than the shareholders, the discount rate can be as high as 90% in some cases.

While the non-trading constraint on compensation contracts causes risk avoidance, lifting the trading barrier also makes equity incentives ineffective (Hall and

Murphy, 2002). Lower-skilled and more risk-averse executives could simply accept and immediately re-sell all options offered (or short-sell equivalent options), thereby reducing or even eliminating the incentive provided by stock options. If managers choose to exercise stock options to buy shares, the incentive carried by the options also diminishes because unlike stock options, there is no performance criterion attached to managerial shareholdings. The above literature suggests that equity incentives are bound to be inefficient, particularly at a high level as they intensify managerial wealth non-diversification.

The non-diversification argument has been addressed or implied in Section 2.3.3 and Section 2.3.4 with regard to the impact of equity delta or managerial shareholdings on managerial risk taking. Non-diversification of managerial wealth portfolio causes a nonlinear relationship between pay-performance sensitivities from various types of equity holdings on managerial risk taking.

2.4.1.1 Empirical evidence

There exists a considerable amount of empirical evidence showing that managers pursue firm risk reducing projects in order to protect their own human capital in the firm. Amihud and Lev (1981) find such evidence in conglomerate mergers which, according to their view, are a type of mergers that allow acquirers to diversify business risk across different sectors but do not necessarily add value for shareholders. But managers can benefit from the decreased firm-specific risk since it can secure their jobs and future income. Based on a sample of acquisitions conducted by 309 large US firms from 1961 to 1970, Amihud and Lev find that management-controlled firms where there are no single shareholders that own 10% or more of the outstanding stocks of a firm are more likely to conduct conglomerate mergers than owner-controlled firms.

May (1995) extends the work of Amihud and Lev (1981). He constructs three alternative measures for diversification level through acquisitions by using the covariance between bidder and target stock returns. These measures capture the combined total risk, firm specific risk prior to acquisitions, and the change of firm total risk resulting from acquisitions. The lower the covariance between bidder and target stock returns, the more diversifying the acquisition. For a sample of 184 acquisitions between 1979 and 1990, he finds that CEOs tend to pursue risk reduction diversification acquisitions when they have higher proportions of their wealth invested in firm equity.

Wright *et al* (1996) demonstrate a nonlinear relationship between managerial shareholdings and managerial risk taking. The latter is defined as 'the analysis and selection of projects that have varying uncertainties associated with their expected outcomes and corresponding cash flows' (p. 442). They argue that at a low level of managerial equity ownership, the relationship between managerial shareholdings and managerial risk taking is positive because managerial wealth benefits from the growth-oriented risky projects that increase firm value. However, when managers obtain a higher level of equity ownership, they may not necessarily increase corporate risk because of the potential risk aversion due to wealth non-diversification. They use a cut off point of 7.5% for managerial shareholdings, below which the equity ownership is considered low and above which it is considered high. They use boards of directors to proxy for firms' managers. Firm risk is proxied by the standard deviation of analysts' forecasts of earnings per share. They explain that uncertainty of analysts' forecasts should be highly correlated with the unpredictability in cash flows generated by a firm's assets, which are a result of managerial risk taking behaviour. Using a sample of 358 firms for 1986, and 514 firms for 1992, Wright *et al* find the results consistent with their hypothesis.

Taken together, the above literature suggests that compensation plans can be ineffective because *inter alias* they reduce the diversification of the managerial wealth portfolio.

2.4.2 Risk aversion - total wealth

Recently theoretical papers by Carpenter (2000) and Ross (2004) suggest another reason why incentive contracts can be ineffective. Managers' risk attitudes vary according to their individual utility functions at different levels of wealth. High levels of wealth make managers more risk averse. The impact of equity incentive thus diminishes as managers' total wealth increases.

Carpenter (2000) argues that the convex nature of stock option payoff[38] does not necessarily encourage managerial risk taking. He demonstrates through his theoretical model that the effects of options on a manager's behaviour depend on his utility function. When a manager is highly risk averse, granting him more stock options that he cannot hedge increases the volatility of his personal wealth portfolio. To offset this, he reduces the volatility of the underlying asset of his stock options. Although Carpenter models a fund manager, the principle applies to a corporate manager who cannot hedge his options in the firm.

Ross (2004) argues that it is far too simple to assume that the shape of the payoff structure can alter managers' attitude towards risk. This assumption neglects that managers' utility function can engender greater or lesser degrees of risk aversion. Take

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[38] The convex payoff of stock options has been defined in Section 2.3.2.4.

a new option grant for an example. The grant has two immediate effects on a manager's wealth. First is that it adds more convexity into the manager's wealth portfolio. The manager should be less risk averse than before if there are no other factors changing his utility function. However, this is unlikely to happen because the option grant also increases the manager's total wealth level, i.e., the second effect, which in turn, alters the manager's utility function. The manager is now likely to be more risk averse than before. Ross states that a manager can have a very different attitude toward risk at a higher level of wealth than at a lower level. The manager is likely to be much more risk averse at a high level of wealth than at a low level of wealth. Ross's argument implies that the impact of an incentive contract on a manager's attitude towards risk is affected by the total wealth of the manager.

Taken together, the above literature implies that to assess the impact of equity-based wealth components, researchers need to consider the influence of managerial total wealth. From the survey of the existing literature in the preparation of this thesis, there appears so far to be no empirical study exploring the effect of total wealth on equity incentives.

2.4.3 Summary

Section 2.4 presents two arguments for why equity-based wealth components can be ineffective in aligning the interests of managers towards that of shareholders. The first is that equity-based wealth reduces the diversification of managerial wealth portfolios and the second is that the incentive provided by managers' equity-based wealth is affected by the level of managers' total wealth.

2.5 Critique of extant studies

Section 2.3 and 2.4 present alternative theories and related empirical evidence regarding the impact of managerial wealth portfolio on managerial risk taking. This section provides a critique of the studies discussed in Section 2.3 and 2.4, and identifies the literature gaps within this area of research.

Summarising the empirical literature, managerial risk taking is usually measured in two ways, *ex post* measures and *ex ante* measures. The *ex post* measures use firm risk as a proxy for managerial risk taking. The logic is that firm risk is a function of managerial risk taking. Managerial risk seeking results in higher firm risk whilst managerial risk reduction such as corporate diversification decreases firm risk. Firm risk is captured by stock return volatility (Agrawal and Mandelker, 1987; Lewellen *et al*, 1987; DeFusco *et al*, 1990; Guay, 1999; Williams and Rao, 2000; Datta *et al*, 2001), by book-to-market ratio (Biziak *et al*, 1993), and by analysts' forecast of earnings per share (Wright *et al*, 1996). However, an *ex post* measure is not a direct measure of managerial risk taking. Such a measure captures some other events that occur after managers' investment decisions have been executed. For example, the war in Iraq depressed the stock price, and increased the stock price volatility of airline companies. If this period is included in calculating an airline company's stock volatility, it will deliver a wrong impression that the increase of the firm risk is because of a project undertaken by the managers prior to the war even though the managers only initiated the project to reduce the firm risk. Now let's use the same example but consider a book-to-market ratio being used to measure firm risk. The airline company's book-to-market ratio will increase because of its stock price decreases. A lower book-to-market ratio indicates lower firm risk. This implies that managers conducted risk reduction projects to reduce firm risk before the war started. Therefore, for the same company over the same period, two *ex post* measures lead to two opposite conclusions about managerial risk taking behaviour.

The above illustration has shown that *ex post* measures of managerial risk taking are problematic. *Ex ante* measures are superior to *ex post* measures because the former is not subject to the problem discussed above. The *Ex ante* measures use investment risk as a proxy for managerial risk taking because investment risk level directly reflects managers' risk preference in project selection. Existing studies have used the following proxies for investment risk: corporate risk diversification (Amihud and Lev, 1981; Hill and Snell, 1988; May, 1995), corporate hedging (Tufano, 1996; Rogers, 2002), R&D investment (Hill and Snell, 1988; Richardson and Waegelein, 2003; Coles *et al*, 2004), oil & gas exploration activities (Rajgopal and Shevlin, 2002). The first two proxies focus on firm risk reduction and the last two focus on firm risk enhancing. Empirical studies on how managerial equity holdings affect managers' choice of risky projects, in particular risk enhancing projects are very limited. Moreover, none of the empirical studies has examined excessive managerial risk taking brought by stock options in the 1990s, an issue that has caught the attention of business journalists, regulators, etc (see Section 2.3.2.4). More academic studies therefore are needed to investigate managerial risk taking behaviour.

In addition to the problem for an appropriate proxy for managerial risk taking in the empirical literature, empirical studies have a number of other areas that need improving. Firstly, none of them considers the effect of managerial total wealth on the risk incentives provided by equity-based wealth components. Thus those studies neglect a potentially important determinant of managers' risk taking behaviour. This has been discussed in Section 2.4.2.

Secondly, extant studies either focus on managerial risk taking or on firm performance. Only a few studies examine both. Defusco *et al* (1990) examine stock return volatility changes as well as market reaction following the approval of stock option plans. Hill and Snell (1988) examine firm innovation, firm diversification and firm performance. Datta *et al* (2001) include the risk profile of acquisitions as well as post-acquisition performance in the analysis. Except Hill and Snell (1988), none of the other studies, however, establishes an explicit link between firm performance and managerial risk taking. The analysis for firm performance and the analysis for managerial risk taking are two separate analyses and do not interact with each other.

Moreover, both Defusco *et al* (1990) and Datta *et al* (2001) use an *ex post* measure, stock return volatility, as a proxy for managerial risk taking, which as discussed earlier in this section does not reflect the direct relationship between managers' choice of risky projects *ex ante* and managerial wealth. Hill and Snell (1988) establish a link between firm performance and firm innovation (i.e., managerial risk taking), between firm performance and firm diversification (i.e, firm risk reduction). However, their study is limited to managerial shareholdings.

Overall, while traditional studies recognise that firm performance is a function of managers' ownership of their firms manifested in mangers' wealth attached to their firms, these studies generally neglect that firms' performance is affected by mangers' wealth through managerial risk taking. Specifically, the components of managers' wealth such as stock options first affect managers' risk attitude, which determines the risk level of investments managers would like to pursue. The outcomes of these investment projects then affect firm performance. Therefore, to properly detect how managerial wealth affects firm performance, researchers should incorporate managerial risk taking into the analysis.

One possible reason why the above traditional agency studies do not investigate the performance consequence of managerial risk taking is that the traditional agency model recognises that managerial risk taking is associated with lower agency costs and consequently better shareholder value (Jensen and Meckling, 1976). Traditional agency theory assumes managers to be risk-averse and shareholders to be risk-neutral. This divergence of interests in their risk preferences creates agency costs for a firm and thus reduces shareholder value. Managerial risk taking can reduce the divergence of interests between managers and shareholders and thus increase firm value. This risk-related agency problem has been discussed in Section 2.2. This line of reasoning is reflected in the argument of Hill and Snell (1988). They state that firm innovation that is a result of managerial risk taking is positively associated with firm performance, while firm diversification which reflects managerial risk aversion is negatively related to firm performance. However, these studies, published before the dotcom bubble of 1990s during which period excessive amounts of stock options were granted to stimulate managers to take risks, do not take excessive managerial risk taking into account (see Section 2.3.2.4 for a discussion of how stock options cause excessive managerial risk taking).

Even without the inducement of stock options managers may be risk-seekers rather than risk-avoiders as postulated by the traditional agency model. Behavioural finance theory argues that the risk aversion assumption about managers' risk attitude is wrong and that managers may exhibit excessive risk preference under the influence of behavioural biases such as overconfidence, hubris, and over-optimism (behavioural biases are discussed in Chapter 3). Excessive managerial risk taking can lead to negative firm performance. If this is true, high risk does not always mean a better return and the traditional agency model is too simple to capture the incentives that motivate managers to take risk. This again implies that the traditional approach of examining risk incentive alignment effect by investigating the relationship between executive compensation and firm performance is not appropriate or adequate.

Overall, the above discussion has demonstrated that managerial risk taking should not be neglected from the wealth-performance analysis. To properly assess the impact of the components of managerial wealth on firm performance, researchers need to conduct a two-stage analysis. The first stage is to examine the impact of managerial wealth on managerial risk taking and the second stage is to analyse firm performance conditional upon the risk taken. This thesis develops this two-stage analysis and the selected methodology is explained in Chapter 6.

Summarising the empirical compensation literature, I also find that most of the existing studies are based on US data and only few studies are about UK executive compensation. The study on the impact of UK executive compensation on managerial risk taking is a vacuum area. The major reason is data availability. Until around 1998, executive pay research in the UK was hampered by poor quality data due to the lack of detailed company disclosure of executive remuneration details. Most of the UK-based research focused only on cash compensation. For example, Cosh (1975), Meeks and Whittington (1975), Main (1971), Gregg *et al* (1993) and Cosh and Hughes (1997) who all study the determinants of UK CEO cash compensation. Following the Greenbury Report (1995) and Hampel Report (1998), the level of disclosure of compensation details in annual reports has increased dramatically, and from the 1997 accounting year, UK annual reports disclose directors' stock option holdings. This makes the examination of the whole executive compensation package feasible.

Moreover, there is a growing controversy over top management pay level in the UK about whether company directors are overpaid to do their jobs (Conyon and Murphy, 2000). An opinion poll commissioned by Financial Times shows that 78% of the 1,002 adults aged 16 and over across the UK regard the directors of UK companies as overpaid (Blitz, 2003). Shareholder rebellions over executive pay packages have hit Barclays, Abbey National, and GlaxoSmithKline (Financial Times, 30 June 2003). The continuing debate with regard to the executive remuneration, coupled with enhanced data availability through the new disclosure requirement presented in the Greenbury (1995) and Hampel (1998) reports, has made research into UK executive pay critically important. Main *et al* (1995), McKnight and Tomkins (1999), Conyon and Murphy (2000), Conyon *et al* (2000), Conyon and Sadler (2001), Conyon and Freeman (2002), Stathopoulos *et al* (2005) all consider the whole executive compensation package and examine the pay-performance link. None of those studies, however, has explored the impact of executive compensation on managerial risk taking.

In addition, Conyon and Murphy (2000) find a substantial pay difference between US and UK executives. This they suggest may be due to the differences in firm hierarchical management structures, taxes, culture, etc. It is therefore questionable whether the conclusions drawn from studies into US corporate compensation are applicable to the UK. Therefore, a separate UK study is needed to contribute to the body of UK corporate compensation literature.

Taken together, the extant studies into managerial wealth and managerial risk taking need to be supplemented so that they include analyses of 1) an *ex ante* measure of managerial risk taking such as a risky investment project; 2) the influence of managerial total wealth, 3) managerial risk-seeking behaviour. In addition, more UK evidence is required.

2.6 Summary

This chapter outlines a review of relevant literature relating to managerial wealth components, managerial risk incentive and managerial risk taking. It first introduces the risk-related agency problem, and then separately discusses the risk incentives provided by different managerial wealth components given their different payoff structures. Prior empirical analysis of such wealth incentives is also presented. Consistent with theoretical arguments, empirical studies find that fixed compensation and annual bonuses have little incentive alignment effect. Equity-based wealth encourages managerial risk taking, but this appears to be due to the convexity of stock options. There exists some evidence that the impact of pay-performance sensitivity, i.e., equity delta, or managerial shareholdings on managerial risk taking could be nonlinear. At a high level, equity-based wealth seems to discourage managerial risk taking because it results in non-diversified managerial wealth which causes managers to diversify firm risk in order to protect their own wealth.

There are three major gaps with existing models and empirical investigation of managerial wealth and managerial risk taking. These gaps relate to 1) limited studies using *ex ante* measures of managerial risk taking, 2) the influence of managerial total wealth on equity incentives, 3) managerial risk-seeking behaviour. In addition, more UK studies are required. This research endeavours to fill these gaps.

Chapter 3

Behavioural Biases and Managerial Risk Taking: Theory and Empirical Evidence

3.1 Introduction

Starting from the mid-1950s, researchers began questioning the traditional finance theory. They argue that it is not feasible for individuals to be fully rational and to consider every alternative when making a decision. Instead, individuals operate under conditions of 'bounded rationality', which limits the alternatives under consideration (Barberis and Thaler, 2002). Individuals are thus subject to behavioural biases. The behavioural agency theory, developed from the traditional agency theory[39] but incorporating behavioural biases of human behaviour, attempts to describe and predict firm behaviour (Cyert and March, 1963). This is of critical importance in corporate finance research because behavioural agency theory recognises that business is transacted through actions and decisions which are influenced by the psychology of the decision maker. By understanding the psychology of the decision maker it will be possible to better understand his behaviour and the decisions he makes. This helps explain firm behaviour that is inconsistent with the assumptions of the traditional agency model.

Managerial risk attitude is one area of divergence between behavioural agency theory and traditional agency theory. In the traditional agency model, risk is defined as

[39] See Section 2.2 of Chapter 2 for a discussion of the traditional agency theory. The traditional agency theory assumes that managers are fully rational.

the distribution of returns and managers who have their financial capital and human capital attached to one firm are considered to be risk-averse to firm-specific risk in addition to market risk (see Section 2.2 of Chapter 2 for more detailed discussions). Behavioural agency theory challenges both the definition of risk and the assumption about managerial risk attitude associated with the traditional agency model. Behavioural agency theory states that it is improper to disregard human behaviour when defining risk since any investment project is conducted by humans (Sitkin and Pablo, 1992). Combining managers' perception with the potential outcome of projects they invest in, behavioural agency theory gives risk a richer definition. A project is considered risky when the expected outcome is uncertain, the goal is hard to achieve or else the outcome is associated with some extreme consequences. The same project may have a larger distribution of returns (i.e., higher risk) when supervised by a manager who is new to an area, while having a smaller distribution of returns (i.e., lower risk) when by a manager who is an expert in that area and has successfully managed many similar projects before.

After stating that project risk varies among individual managers, behavioural agency theory then suggests that managers are not homogeneously risk averse. Instead, managers' risk attitudes are influenced by their behavioural biases that arise when they form beliefs, and as a consequence of their preferences (March and Shapira, 1987; Kahneman and Lado, 1993; Wiseman and Gomez-Mejia, 1998; Wright *et al*, 2001). Managers can be risk-seeking as well as risk-averse. From the extant studies it appears that three behavioural biases are commonly argued to have influences on managers' risk attitudes. They are overconfidence, over-optimism and hubris, all of which cause managers to underestimate project risk and can lead to excessive managerial risk taking

(Taylor and Brown, 1988; Hayward and Hambrick, 1997). To measure managers' behavioural biases is by no means an easy task. Nevertheless, starting from Hayward and Hambrick (1997), researchers have employed several proxies such as past performance, media profile, etc. In this way researchers have been able to incorporate the behavioural agency model into the area of traditional corporate finance.

This chapter presents the theory and empirical evidence with regard to how managerial behavioural biases influence managerial risk taking. Section 3.2 outlines the theoretical arguments and Section 3.3 provides empirical evidence. Section 3.4 summarises this chapter and discusses the implications of the behavioural agency model for the study of managerial risk taking in general and corporate acquisitions in particular.

3.2 Behavioural biases and managerial risk taking: theory

Behavioural agency theorists argue that managerial risk seeking is not a mere deviation from the traditional agency model's assumption of rational risk aversion. They criticize the risk aversion assumption as being too restrictive and an unrealistic presentation of human behaviour (Wiseman and Gomez-Mejia, 1998; Wright *et al*, 2001). Instead, they argue that managers may be 'irrational' and, under psychological influences, exhibit different attitudes towards risk in different situations. Therefore, incentive alignment mechanisms, designed on the assumption that managers are rational and risk averse, are unlikely to influence irrational and risk-seeking managers in the desired direction (Barberis and Thaler, 2002). "These managers *think* that they are maximizing firm value, even if in reality, they are not. Since they think that they are already doing the right thing, stock options or debt are unlikely to change their behaviour." (Barberis and Thaler, 2002, p.58). Such a managerial attitude may be due less to a fraudulent intent than it is to behavioural biases such as overconfidence, hubris and over-optimism. Existing literature has shown that these three behavioural biases induce managerial excessive risk taking. In the following subsections, I discuss these three behavioural biases separately.

Overconfidence

Extensive evidence shows that people are often overconfident in their judgments (Shiller, 2001; Barberis and Thaler, 2002). In one experiment conducted by those studies to demonstrate individual overconfidence, participants were asked to read about the general information in a multiple-choice format and are then asked to choose the most likely answer and assign the probability of their being correct to it. Researchers found that respondents often describe themselves as "90% sure" while only being correct on about 80% of cases.

Researchers have found that managers, particularly senior managers are prone to display overconfidence (March and Shapira, 1987; Goel and Thakor, 2000). March and Shapira (1987) find that managers view risk as controllable and modifiable and that they themselves are able to clearly distinguish between gambling - where the chances of winning or losing are uncontrollable - and risk taking - where uncertainty can be reduced by skill or information. This can be illustrated by the words of the president of a successful high technology company: "In starting my company I didn't gamble; I was confident we were going to succeed." (March and Shapira, 1987, p.1410). Goel and Thakor (2000) develop a model in which managers' ability are judged relative to each other to determine who should be appointed the leader of the group. Managers make unobservable choices about the payoff distributions of the projects they will manage, and their abilities are inferred *ex post* from observed project outcomes. Goel and Thakor find that all managers choose higher levels of project risks when they are competing for leadership. They also find that an overconfident manager – one who underestimates his project risk – has a higher probability of being chosen as the leader than an otherwise identical manager.

Over-optimism

Overoptimistic individuals underestimate the likelihood of hazards affecting them personally, and entertain the unlikely belief that the future will be great for them (Kahneman and Lovallo, 1993). Taylor and Brown (1988) suggest that over-optimism may come from 1) unrealistic, positive self-evaluations, 2) unrealistic optimism about future events, and 3) an illusion of control[40]. People tend to exaggerate their control over events, and the level of the skills and resources they possess in ensuring desirable outcomes. Over-optimism is similar to overconfidence in that both behavioural biases make individuals overestimate their own capability of delivering successful results.

Kahneman and Lovallo (1993) state that a substantial degree of risk to which managers willingly expose themselves is unlikely to reflect the true acceptance of these risks, but is because they misjudge the odds, or they rely on overly optimistic forecasts. Heaton (2002) argues in his theoretical models that over-optimism causes managers to over-estimate their ability to generate returns, to perceive their own firm stocks to be undervalued by the market. Overoptimistic managers prefer using internal funds to issuing firm stocks to finance investment projects because they believe firm stocks are undervalued by the stock market. Moreover, optimistic managers often show an

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[40] This may also lead to overconfidence.

upward bias in forecasting the cash flows of investment projects. This causes such managers to overvalue their firms' investment opportunities and to undertake projects that may even have negative cash flows. Both cases will cause firm value destruction. Based on Heaton's argument, Malmendier and Tate (2005b) hypothesize that overconfident/over-optimistic managers invest more when they have internal funds at their proposal. For a sample of 477 large US firms from 1980 to 1994, Malmendier and Tate find a strong positive correlation between the sensitivity of investment to cash flow and CEO overconfidence/over-optimism[41], therefore proving Heaton's argument that managerial over-optimism lead to suboptimal investment behaviour.

Hubris

Hubris, is 'exaggerated pride or self-confidence, often resulting in retribution' according to Webster Dictionary. Hubris is derived from Greek mythology (Hayward and Hambrick, 1997). In Greek mythology, those who are excessively confident, or blindly ambitious are ruthlessly struck down by the gods. Roll (1986) develops a hubris hypothesis of corporate takeovers that is further developed and tested by Hayward and Hambrick (1997). When managers consider taking over another firm, they conduct a valuation analysis of that firm. They will launch a bid if their valuation exceeds the market price of the target, but hubris can cause managers to underestimate the risk inherent in the takeover, leading to the overvaluation of the target. Hubris-affected

[41] Malmendier and Tate (2005b) classify CEOs as overconfident if CEOs repeatedly do not exercise their firm stock options even firm stock prices exceeds the option stock prices, or if CEOs habitually acquire stocks of their company.

managers may pay excessive takeover premiums, and consequently cause value destruction for acquirer shareholders.

Summarising the discussions of overconfidence, over-optimism, and hubris, it appears that all three cause managers to overestimate their capabilities and underestimate investment risk, therefore potentially causing firm value destruction. It is therefore very difficult to distinguish the three effects on managerial risk taking from each other. Empirical studies have already mixed these concepts together. For example, the theoretical model developed by Heaton (2002) describes the behaviour of overoptimistic managers. Malmendier and Tate (2005b) test the Heaton (2002) model but refer to the behaviour of overconfident managers. Hayward and Hambrick (1997) also mix hubris and overconfidence in their paper. More empirical studies are listed in the next section. As discussed earlier in earlier subsections, there exist subtle differences between these three behavioural biases even though they all induce excessive managerial risk taking. In many prior empirical studies these differences tend to be blurred. Therefore, this thesis uses the term 'behavioural biases' to refer to their common character, i.e., they cause managers to underestimate project risk and encourage excessive risk taking.

In contrast to the argument of the papers discussed earlier in this section that behavioural biases lead to firm value destruction, Goel and Thakor (2000) theorise that overconfidence can enhance firm value. An overconfident CEO, because of his strong conviction in the success of his projects, is quite adept at motivating the workers around him. His 'cheerleading' may in fact be an asset to the corporation. This theory however so far has not been empirically tested.

Collectively, the above studies quite plausibly explain the existence of behavioural biases in managers' psychology and that behavioural biases encourage managers to pursue excessively risky projects, leading to firm value destruction. Only one study states that some behavioural biases may enhance firm value.

3.3 Empirical evidence

Following the theoretical arguments presented in Section 3.2, this section reviews the related number of empirical studies and discusses some empirical issues relating to quantifying behavioural biases. Whilst none of the studies presents empirical evidence on how managerial behavioural biases affect the process by which managers go about choosing over-risky projects, all of the studies do associate behavioural biases with firm performance. This section therefore presents the empirical evidence on the relationship between firm performance and managerial behavioural biases.

A difficult task faced by empirical behavioural studies is the qualification of behavioural biases. Take overconfidence for example, a measure of managers' overconfidence requires data that discloses each manager's psychology. This is difficult, if not impossible, to obtain. In addition, how to define the borderline that distinguishes 'over' confidence and 'normal' confidence is another big obstacle. These problems place real limits on empirical studies of managers' behavioural biases in corporate finance. There are however, a few notable exceptions and they are discussed in the following paragraphs.

Roll (1986) examines hubris in the context of corporate takeovers and suggests a hubris hypothesis. Hubris causes bidder managers to believe that their own valuation of the target firm is correct while the market does not fully reflect the full economic value of the target firm as well as the value of the combined bidding and target firm. Bidder managers are therefore likely to pay higher acquisition premiums, causing value transfer from bidder shareholders to target shareholders. The hubris hypothesis implies that if there are absolutely no gains available to an acquisition, the average increase in the target firm's market value should then be more than be offset by the average decrease in the bidding firm's market value. The acquisition costs should make the acquisition a net loss. Moreover, the target market value should increase when an unanticipated acquisition is announced, and it should go back to the original level when the bidding is unsuccessful. Roll conducts a thorough prior empirical literature review of value gains from corporate acquisitions and finds evidence consistent with the predictions of the hubris hypothesis. He therefore concludes that managers' hubris is one of the reasons for corporate mergers. Roll's way of identifying hubris is based on the assumption that financial markets are efficient in reflecting all the information about individual firms, i.e., strong-form market efficiency. Following the Roll (1986) approach and based on a sample of 330 US tender offers made during 1963-1988, Elazar and Narayanan (1993) draw the same conclusions as Roll (1986).

However, these studies do not use proxies for managerial hubris other than suggesting or implying its existence in acquisitions. Hayward and Hambrick (1997) do find some plausible empirical measures and in their paper reporting their investigation into how hubris affects value destruction in mergers. They use four proxies: 1) acquiring company's recent performance as measured by acquirer stock price momentum 1 year prior to acquisition announcement; 2) recent media praise; 3) CEO's self-importance[42]; 4) a factor based on a combination of the first three factors. Further

[42] Hayward and Hambrick (1997) also use self-importance measured by CEOs' pay level as a proxy for hubris (see Section 6.2.1.3 of Chapter 6).

discussions of how these proxies are associated with managerial hubris or other behavioural biases can be found later in Section 6.2.1.3 of Chapter 6. Using a sample of 106 large US acquisitions, Hayward and Hambrick find that all of the proxies they use are highly positively associated with the size of acquisition premiums paid while acquisition premiums are significantly negatively related to one-year post acquisition cumulative abnormal returns. Hayward and Hambrick conclude that managerial hubris destroys acquirer shareholder value.

Hletala *et al* (2003) try to infer the market's estimates of synergies, bidder overpayment, and changes in bidder and target values from the stock prices around a takeover announcement. They use the takeover contest for Paramount in 1994 as an example. They find that Viacom, the acquirer, overpaid by more than $2 billion when it agreed to purchase Paramount. This overpayment occurred despite the fact that Summer Redstone, the CEO of Viacom, owned roughly two thirds of Viacom. Hletala *et al* state that this substantial ownership means the overpayment is less likely to be due to the agency problem, but is more likely to be due to the overvaluation of Paramount by Summer Redstone, a sign of his overconfidence or hubris. Hletala *et al* also analyse other factors that contribute to Summer Redstone's overconfidence/hubris. They suggest that the great success Summer Redstone, and Viacom itself had enjoyed prior to that acquisition fostered his hubris which led to overpayment for the acquisition. As Hayward and Hambrick (1997), Hletala *et al* imply that good past performance contributes to overconfidence/hubris.

Rau and Vermaelen (1998), Kohers and Kohers (2001) and Sudarsanam and Mahate (2003) suggest that the ratio of acquirer book value of equity to market value of equity ('book-to-market ratio' hereafter) indicating glamour or value status contributes to managers' hubris/over-optimism. The stocks of firms with low book-to-market ratios are called 'glamour stocks' or 'growth stocks'. A low book-to-market ratio indicates that the market thinks the firm has high growth opportunities. The market's perception may come from that the firm consistently producing rising sales or earnings. Opposite to glamour stocks are value stocks which have high book-to-market ratios, indicating that the market thinks the value of those firms is mainly from real assets which have been recorded on accounting books and the firms have limited growth potential. The glamour or value status of firm stocks may affect bidder managers' acquisition strategies. The glamour status can make bidder managers over-optimistic about the future investment prospects of their firms and it is likely that this over-optimism will lead to a risky acquisition strategy, overpayment of acquisition premiums and value destruction of acquirer shareholders. By contrast, bidder managers of value firms may be more prudent in estimating an acquisition benefits and therefore are less likely to substantially overpay for target firms.

For a sample of 3,169 mergers and 348 tender offers from 1980 to 1991 in the US, Rau and Vermaelen (1998) find that glamour bidders underperform value bidders in both mergers and tender offers during the three years after the acquisitions are made. In the merger sample, glamour acquirers have cumulative abnormal stock returns of −17.26% (significant at the 1% level) as compared to 7.64% (significant at the 1% level) for value acquirers. In the tender offer sample, glamour acquirers achieved a statistically insignificant 4.25% abnormal stock returns as compared to 15.53% (significant at the 1% level) achieved by value acquirers. Kohers and Kohers (2001) investigate 304 US high-tech mergers from 1984 to 1995 and find that on average glamour bidders underperform value bidders by 71.38% (significant at the 1% level) over 3 years following the acquisition. For a sample of 519 UK acquisitions from 1983 to 1995, Sudarsanam and Mahate (2003) find that on average glamour bidders underperform value bidders by 1.7% (significant at the 10% level) 750 days after acquisition announcement.

Malmendier and Tate (2004) investigate how CEO overconfidence can affect corporate acquisitions. They employ two measures for CEO overconfidence, the time at which CEOs exercise the options of their company stocks and press coverage. CEOs have undiversified wealth portfolios (see Section 2.4.1 of Chapter 2), which is likely to expose CEOs' wealth to too much firm-specific risk. CEOs therefore are likely to exercise options early, given a sufficiently high stock price to reduce their risk exposure. However, if CEOs constantly hold back from exercising their options even after the firm's stock price exceeds the option strike price, i.e., options are in-the-money, it implies that CEOs are persistently bullish about their companies' future prospects. This could be because CEOs are overconfident in their capability to improve firm performance. Malmendier and Tate also classify CEOs as overconfident if the press describes them as "overconfident" or "optimistic". Analysing a sample of 477 large publicly-traded firms from 1980 to 1994, they find that overconfident CEOs are more likely to conduct mergers, in particular, value-destroying mergers, than are rational CEOs. In addition, they also find that the market reacts significantly more negatively to takeover bids by managers perceived to be overconfident.

Malmendier and Tate (2005a) analyse the impact of winning a high-profile tournament on the subsequent behaviour of the winner in the context of CEOs of US corporations. Malmendier and Tate state that the "superstar" status gives rise to CEO hubris which makes CEOs' performance decline. They construct a sample of superstar

CEOs which covers all CEOs who received CEO awards from Business Week, Financial World, Chief Executive, Forbes, Industry Week. Morningstar.com, Time, CNN, Electronic Business Magazine, and Ernst & Young between 1975 and 2002. Malmendier and Tate find that superstar CEOs spend significantly more time and effort on public and private activities outside their company, such as assuming board seats or writing books. Superstar CEOs are more likely to manage earnings and their firms are more likely to experience negative earnings after several years have elapsed following their last award.

Collectively, the above studies show that managerial behavioural biases, which cause many managers to overestimate their ability and underestimate project risk, lead to shareholder value destruction. Typical examples are found in M&As.

3.4 Implication of behavioural agency model on managerial risk taking

This chapter presents the behavioural agency view that managers can exhibit a risk-seeking attitudes due to behavioural biases such as overconfidence, over-optimism and hubris. Under the influences of these biases, managers are likely to overestimate their abilities and under-estimate project risks. Managerial excessive risk taking is common and often associated with negative firm performance. The behavioural agency model casts doubt on the traditional agency studies discussed in Chapter 2 which do not recognise managers' 'irrational' behaviour and simply assume that managers are universally risk averse and that managerial risk taking, regardless the degree of risk taking, aligns the interests of shareholders and managers and can improve firm performance. As discussed in Section 2.5 of Chapter 5, traditional agency studies generally do not emphasize managerial risk taking when estimating the risk incentive effect of executive compensation on firm performance. The behavioural agency model has made the examination of managerial risk taking critically important because it suggests that managers' excessive risk taking, as managerial risk avoidance, can also lead to firm value destruction.

Interestingly, although risk is at the core of the behavioural agency model, empirical finance studies based on the behavioural agency model do not examine to what extent those behavioural biases are associated with managerial risk taking. As with the traditional agency studies discussed in Chapter 2, those behavioural agency studies simply examine the link between firm performance and behavioural biases, assuming that those biases can cause negative firm performance. They also do not consider the effect of managerial wealth in their model. During the bull market of the late 1990s, equities were highly overvalued; excessive amounts of stock options were granted to give managers more incentive to seek risks; companies, particularly internet and telecom companies, enjoyed excessively 'good' stock price performance; many superstar CEOs were created by the media for their 'substantial' contribution to such performance. For instance, Jean-Marie Messier, the CEO of Vivendi Universal, became one of these superstars and tried to establish a world's leading media empire, on the foundation of a 150-year-old French water company, within 8 years from 1994 (Johnson and Orange, 2003). This is an era full of managerial risk taking activities driven both by behavioural biases and by executive compensation in the form of equity and stock options. It is hard to tell which of these factors induced managers to pursue excessive investment risk, which, in turn, might have caused the stock market crash of early 2000. It is therefore critically important to combine the views of the traditional agency model and the behavioural agency model to investigate managerial risk taking behaviour in the 1990s.

How do shareholders ensure that the mix of risk incentives from managerial wealth and behavioural biases leads to neither too much risk taking nor too little? Corporate monitoring mechanisms through their monitoring role can steer managers towards optimal risk and avoid value destroying risk-deficit or risk-excess on the part of their managers. In the next chapter, I discuss theories and empirical evidence related to corporate monitoring mechanisms.

Chapter 4

Monitoring Mechanisms and Managerial Risk Taking: Theory and Empirical Evidence

4.1 Introduction

We have seen in Chapter 2 that some managerial wealth components can induce managerial risk aversion while others can encourage managers to seek more risk. Chapter 3 suggests that behavioural biases can drive managers to indulge in excessively risky investments. Risk incentives from wealth components together with behavioural biases may result in managers pursuing suboptimally risky investments. Therefore, shareholders may need other levers to ensure managers pursue neither too little nor too much risk.

Monitoring is one of the key corporate control devices. Monitors such as non-executive directors, or external blockholders, directly observe and evaluate managers' behaviour, the results such behaviour produces or both, to ensure that managers' decisions are consistent with shareholder objectives (Fama and Jensen, 1983). A strong remuneration committee can attempt to structure executive compensation packages in such a way that they will motivate managers to maximise firm value. A good corporate control system can also constrain managers with behavioural biases from indulging in excessive risk-seeking activities (Hayward and Hambrick, 1997; Malmendier and Tate, 2004; Malmendier and Tate, 2005a). In summary, optimal monitoring can curb suboptimal risk avoidance and excessive risk preference among managers and this should be associated with shareholder value enhancement.

This chapter presents theories of how various corporate monitors may align managers' interests with those of shareholders and related empirical evidence. Section 4.2 discusses four types of monitoring mechanisms: external blockholders, board independence, separation of CEO and chairman of board roles and remuneration committees. Empirical evidence is also provided in each subsection. Section 4.3 is the chapter summary.

4.2 Monitoring mechanisms and firm risk taking

In the presence of the principal-agent problem, shareholders develop corporate monitoring mechanisms to ensure that managerial decisions safeguard their own interests against the hazards of managerial self-interest. Many studies have shown that firms with weaker governance structures have greater agency problems and that firms with greater agency problems perform worse (Core *et al*, 1999; Gugler *et al*, 2003). Jong *et al* (2005) use Royal Ahold as an example to illustrate what a corporate governance failure can bring to a company. Royal Ahold was one of the world's largest international retail grocery and food service companies. It was a family business owned by the Hejin Family, operating primarily in Netherlands for over 100 years. In 1989, Ahold was transformed from a family-controlled business to a management-controlled firm. It then adopted an expansion strategy via a series of large-scale acquisitions and turned into a global giant with a market capitalisation of €30.6 billion and operating 5,155 stores in 27 countries by November 2001. However, in 2002, Ahold was charged with: hidden contractual obligations, manipulation through the consolidation of joint ventures and fraud involving vendor rebates. In 2003, Ahold suffered a complete meltdown and went to liquidation. Poor corporate governance, specifically, the absence of internal as well as external supervision of managers' strategy and implementation, was a significant factor in Ahold's collapse. Managers were in effect in total control of the firm. Van der Hoeven, the CEO, put voting control of the institutional investors' holdings in a foundation, whose board was strongly influenced by Ahold's management. This deprived shareholders of the ability to monitor managers on a daily basis. Management also controlled two boards, the supervisory board and the management board. The supervisory board was where growth objectives and strategy should have been debated, implementation of strategy monitored and oversight maintained. The management board established the incentive compensation system. The management board then granted incentive plans that rewarded earnings growth, which in turn, provided a direct motivation for managers valuing growth over shareholder value. Ahold pursued a quick growth strategy by engaging in a series of acquisitions. Those 'bad' acquisitions combined with accounting fraud and loss of investor confidence eventually led to the collapse of the company.

Drawing upon the extensive corporate monitoring literature, this thesis focuses on four mechanisms that are likely to have impact on managerial risk preferences: external blockholders, board independence, the separation of the roles of chief executive officer and chairman of board and the presence of a remuneration committee. Each of these components is discussed in the following subsections.

4.2.1 External blockholders

External blockholders have stronger economic incentives than small atomistic external shareholders to undertake effective monitoring. This is because the former are able to capture a large fraction of the wealth gains arising from corporate value enhancement, whereas the latter cannot bare the costs associated with effective monitoring (Shleifer and Vishny, 1986). External blockers can exert a corporate monitoring function by promoting an appropriate management compensation structure, by strengthening shareholders' voice on the board, by forcing managers to revise project proposals that may harm shareholder value, etc. Shleifer and Vishny (1986) present a model in which a takeover can be successful only when the bidder has already acquired a large minority ownership position in the firm. The potential takeover threat that large outside shareholders can exert works as an effective device for monitoring management. Thus, Shleifer and Vishny predict that, all else being equal, the presence of a large outside shareholder will have a positive effect on shareholders' wealth.

An important component of external shareholders is institutional investors (Brickley *et al*, 1988). Institutional shareholders collectively are the largest owners of shares in the US and the UK. They perform high quality research in order to identify efficient firms in which to invest funds. Some institutional shareholders communicate directly with senior managers and thus may influence the terms of investments so as to maximise shareholder returns. Gillan and Starks (2000) demonstrate that institutional investors are the key players in shareholder activism. Using a sample of 2,042 shareholder proposals submitted to 452 company boards from 1987 to 1994, Gillan and Starkes find that activism by institutional shareholders and coordinated groups brings about significantly more favourable voting outcomes than activism by uncoordinated groups of shareholders. Malmendier and Tate (2005a) argue that institutional shareholders may prevent behavioural biases from inducing CEOs to conduct corporate activities that are not in the best interest of shareholders and that destroy shareholder value.

Other authors however argue that external blockholders can be ineffective. Family and individual shareholders are quite often descendents of the corporate founder.

They hold the shares purely as a passive investment, taking little interest in corporate activities (McConnell and Servaes, 1990). Institutional investors such as banks and insurance companies, frequently derive benefits from lines of business which fall under the control of managers of firms in which they hold a stake. Therefore, they are often subject to management influence (Brickley *et al*, 1988). Public pension funds are often managed by officials with their own personal agendas such as campaigning for public office, their goals may not be consistent with maximizing shareholder value (Woidtke, 2002). These things are less likely to happen to mutual fund and foundations. Nevertheless, Franks *et al* (2001) report that when institutional shareholders are dissatisfied with management, instead of taking an active role in the decision-making process, they just sell shares[43]. If institutional shareholders sell a large block of shares, the selling activity may push down the stock price thereby adversely affecting shareholder value.

Taken together, whether or not external blockholders are effective in disciplining management behaviour is debatable. Empirical evidence is provided in the following section.

4.2.1.1 Empirical evidence

Although a vast amount of empirical research has been conducted on the topic of external blockholders or institutional shareholders as a corporate control device, there

[43] Parrino *et al* (2003) however argue that institutional selling can influence board of directors' decision about whether or not to force a badly-performed CEO from office and select a new CEO. The forced CEO turnover is positively related to firm performance. They provide empirical support for this argument based on a sample of 583 CEO turnovers at large US public corporations over 1982 -1993

are only a limited number of studies that address their influence on managerial risk taking. There are however a small number of empirical studies on how external blockholders or institutional shareholders affect acquisition decisions as well as the value creation from acquisitions.

Hill and Snell (1988) examine innovation strategy in research-intensive industries such as the Chemicals, Electrical and Electronics, Computers, Industrial and Farm Equipment and Pharmaceutical industries. In such industries, research-based innovations are regarded as high-risk/high-return investments. For a sample of 94 Fortune 500 firms, Hill and Snell find that external blockholdings are significantly (at the 1% level) positively related to firm R&D intensity, while R&D intensity is shown to significantly (at the 1% level) contribute to firm performance as measured by return on asset. This implies that external blockholders encourage managerial risk taking.

Zahra (1996) examines the impact of corporate governance on entrepreneurial risk taking in large US industrial corporations. Zahra states that corporate entrepreneurship such as innovation aimed at business creation and venturing, can enhance shareholders' value by creating a work environment that supports individual and corporate growth and by bringing competitive advantage to the company. However, managers try to avoid corporate entrepreneurship because of their risk averse attitude (see Section 2.2 of Chapter 2 for a discussion of managerial risk aversion). Institutional shareholders can curb this managerial risk avoidance and support corporate entrepreneurship. Zahra measures corporate entrepreneurial activities by using activities linked to R&D investment, patents, new products, new markets, etc. For a sample of 138 firms from 1988 Fortune 500 list, Zahra finds that only long-term institutional shareholders such as mutual funds and pension funds are positively associated with innovation and venturing, and that short-term institutional shareholders such as investment banks and private funds are not. Zahra explains that long-term institutional shareholders are generally large and have long investment durations. Managers of such funds are interested in their portfolios' long-term value. In contrast, short-term institutional funds are evaluated quarterly, which may promote short-term investment horizons. That's why managers of such funds do not favour corporate innovation and venturing which has a long investment horizon.

Tufano (1996) examines corporate risk management activities in the North American gold mining industry. Given that the output of such an industry is a globally-traded volatile commodity, firms in this industry are considered to have high risk profiles. By investigating 48 North American Mining firms from 1990-1993, Tufano finds that corporate hedging activities against gold price risk are conducted mainly due to managers' risk aversion. When managers of gold mining firm hold a large investment in their firms' common stock, they hedge more against gold price risk. Tufano finds that the existence of external blockholders can make managers hedge gold price risk less.

Wright *et al* (1996) investigate how external blockholdings affect managerial risk taking. Firm risk is proxied by the standard deviation of analysts' forecasts of earnings per share. They explain that uncertainty of analysts' forecasts should be highly correlated with the unpredictability in cash flows generated by a firm's assets, which is a result of managerial risk taking behaviour. Managers are risk averse and are not willing to undertake more risky investments (see Section 2.2 of Chapter 2 for a discussion of risk-related agency problem). Managerial risk aversion is more harmful in firms with rich growth opportunities than in firms with few growth opportunities.

External blockholders or institutional shareholders should exert effective corporate control and prevent managers' avoidance of growth-oriented risky projects. Using a sample of 358 firms for 1986, and 514 firms for 1992, Wright *et al* find results consistent with their arguments. They find a positive association between managerial risk taking and institutional equity ownership for companies with considerable growth opportunities, but find an insignificant association for firms without such opportunities. Viewing external blockholders as a whole, they do not find any significant relationship between firm risk level and external blockholdings. Wright *et al* explain that this may be because some of the external blockholders, such as family and individual shareholders, may be passive investors. When passive investors dominate the external blockholders, the monitoring role of external blockholders may indeed be small.

Collectively, the above relevant studies report mixed results for the monitoring effect of external blockholders on managerial risk taking. Expanding the discussion to studies that investigate the impact of external blockholders on acquisition decisions and value creation through acquisitions, the results are even more controversial. Cosh *et al* (1989) examine the role of institutional shareholders in acquisitions during the 1980s. They expect that institutional shareholders, as the principal blockholders in the UK during the 1980s, ought to influence acquisition decisions such that the acquisition increases shareholder value. Under the control of institutional shareholders, acquiring companies will be discouraged from making acquisitions in pursuit of managers' empire building or other managers' self-interests at the expense of shareholder value. Cosh *et al* use a dichotomous classification for the influence of institutional shareholders. Acquirers who have a financial institution shareholding of 5% or more in the year prior to acquisitions are classified as potentially subject to influence from financial institutions. Acquisition performance is measured by profitability (i.e., pre-tax returns on average net assets), or share returns (i.e., post-tax returns on shares). For 59 mergers in the low acquisition period of 1981-1983, Cosh *et al* find that the shareholders of acquirers which have institutional shareholder control experience significantly higher profitability and share returns following acquisitions. However, such evidence is not found in the sample of 77 acquisitions in 1986, the bull acquisition activity period. Cosh *et al* therefore suggest that the impact of institutional shareholders on acquisition performance is inconclusive and needs more examination.

Using a sample of 846 corporate acquisitions from the period from 1978-1988, Martin (1996) finds that the likelihood of stock financing, which typically reduces the wealth of acquiring firm's shareholders, decreases with the level of external blockholdings associated with the acquirer. This finding implies that external blockholders discipline managers in their decisions to use stock financing in acquisitions because such a means of payment reduces shareholder value.

Sudarsanam *et al* (1996) examine the impact of external large shareholders on acquirer shareholder wealth gains through acquisitions. They argue that if large shareholder monitoring of managers' behaviour is efficient, acquirer shareholders should experience wealth gains following the acquisitions. Where monitoring is inefficient, bidder managers may make value-destroying acquisitions or pay excessive premiums as a result of hubris and cause wealth loss for their shareholders. For a sample of 429 UK domestic acquisitions from 1980 to 1990, they find a significantly (at the 5% level) negative relationship between the acquirer announcement period cumulative abnormal returns and the shareholdings of external blockholders.

Sudarsanam *et al* conclude that monitoring the acquisition decisions of acquirers by large shareholders is ineffective.

Duggal and Millar (1999) employ corporate takeover decisions to investigate the impact of institutional ownership on corporate performance. They postulate that if institutional shareholders are active corporate monitors who support (oppose) managers' firm value enhancing (reducing) policies and decisions, then their presence should increase acquirer shareholder value. Such a positive relationship between acquirer shareholder value and institutional ownership is unlikely to be found if institutional shareholders are passive investors who just sell their holdings in poorly performing companies rather than expend their resources in monitoring and improving firm performance. For a sample of 120 US firms who conducted acquisitions over the 1985-1990 period, Duggal and Millar find no relationship between bidder gains as measured by bidders' announcement period cumulative abnormal returns and institutional ownership. They therefore conclude that institutional investors do not exercise effective corporate control to enhance bidder shareholder value.

Kohers and Kohers (2001) examine the agency problem in high-tech mergers over the period 1984 to 1995. They postulate that, as acquiring risky high-tech companies might quickly and greatly stimulate the growth of the buyers, this would be especially appealing to self-interested managers who are susceptible to agency problems. Institutional shareholders in such firms should check managers' self-interests. Acquisitions taken under the control of institutional shareholders should enhance shareholder value. For a sample of 304 US takeovers, Kohers and Kohers find that institutional ownership is positively related to the bidder's 3-year post-acquisition performance as measured by buy-and-hold abnormal stock returns. Kohers and Kohers conclude that institutional shareholders contribute to better post-acquisition performance of high-tech mergers.

Overall, the studies of the impact of external blockholders on takeover decisions and value creation of acquirers' shareholder value show inconsistent results for the efficiency of the monitoring function of external blockholders.

There also exist other studies that examine the effectiveness of large outside shareholders. Briefly, Boubakri *et al* (2004) report that external blockholdings are significantly positively related to post-privatisation firm performance. McConnell and Servaes (1990) report a positive relationship between Tobin's Q and the fraction of shares owned by institutional investors. Huson *et al* (2004) document that institutional shareholdings are significantly positively related to post CEO turnover performance. Uang *et al* (2004) find that institutional shareholders can prevent managers of financially distressed companies from not truthfully reporting companies' going concern status[44]. Core *et al* (1999) suggest that the existence of external blockholdings can control the excessive pay granted to CEOs. However, Cosh and Hughes (1997) in their UK-based study, find that the presence or absence of institutional shareholders makes no difference to the levels of CEO pay or CEO dismissal, implying that institutional shareholders are passive investors rather than active investors, who do not engage in designing remuneration packages that align the interests of shareholders and managers, and do not dismiss CEOs who perform badly.

Sudarsanam *et al* (1996), Franks *et al* (2001), and Weir *et al* (2002) all conducted UK studies. Franks *et al* (2001) investigate to what extent corporate control

[44] Going concern is bad news for companies. It shows bad management in those companies. Therefore managers try to cover it up.

devices serve to discipline of poorly performing management. For a UK sample of 243 firms over 1988-1993, they find that large UK external shareholders exert little disciplining effect on managers. An alliance of the five biggest shareholders can on average control more than 30% of company shares. However, there is little evidence to suggest that they unite to perform their corporate control function. On the contrary, the main source of large shareholder control comes from that which lies in the hands of inside managers and these are used to entrench rather than to discipline management. Weir *et al* (2002) examine the impact of external blockholdings on firm performance. They argue that the existence of external blockholders should enhance firm performance because external blockholders reduce agency costs. They use Tobin's Q measured by market capitalisation plus total debt divided by total assets as a proxy for firm performance. They find little relationship between performance and external blockholdings for a sample of 311 large UK public firms over the period 1994-1996. Sudarsanam *et al* (1996) find that acquirer's large shareholders are ineffective in monitoring acquisition decisions. Overall, the above studies are inconclusive as to whether or not large outside shareholders perform disciplinary functions on managers in the UK.

4.2.1.2 Summary

Some studies suggest that external blockholders as well as institutional investors can provide efficient monitoring of managers' behaviour. Those large outside shareholders are argued to be able to curb both managerial risk avoidance and excessive managerial risk taking influenced by behavioural biases. Other studies however argue that external blockholders do not provide efficient monitoring of managers' behaviour. Empirical studies provide inconsistent results. While there are a limited number of empirical studies reporting the impact of external blockholders on managerial risk avoidance, there are no such studies showing that they prevent managerial excessive risk seeking. Studies are needed in these areas.

4.2.2 Board independence

One of the roles of a board of directors is to ensure separation of decision management and control since the board always has the power to hire, fire and compensate the top-level decision managers and to ratify and monitor important decisions (Fama and Jensen, 1983). Corporate boards in the UK and several other countries, like the US, are generally comprised of both executive directors and non-executive directors. As professional managers themselves, the interests of executive directors are theorized to be aligned with the other managers in the firm. As Mace (1971) notes, executive directors believe that they are being evaluated by the insiders, and they often are, as potential candidates for the CEO's successor.

Non-executive directors are theorised to be aligned with those of stockholders. They act as arbiters in disagreements among internal managers and carry out tasks that involve serious agency problems between internal managers and external shareholders (Fama, 1980; Fama and Jensen, 1983). A second role of non-executives is to review the performance of the board and of the executives (Cadbury Report, 1992). Non-executive directors possess three characteristics that enable them to fulfill their monitoring function. First, they have certain legal obligations to shareholders and they can be held liable for damages if they fail to meet these obligations. Second is their independence. Third, they will have some desire to maintain or establish their reputations as good monitors and competent business people. Successive UK corporate governance regimes from the Cadbury Report in 1992 to the most recent Higgs Report in 2003 have emphasised the critical role of non-executive directors and laid down guidelines for ensuring their independence.

Therefore, the ability of the board to act as a guardian of stockholder welfare is a function of board composition (Mizruchi, 1983). If management dominates the board, then even in the event of deteriorating performance, managers' position should remain secure. If, on the other hand, the board has control over management, then top management may be ousted by the board. Ranft and Neill (2001) suggest the existence of narcissistic leaders who isolate themselves from the advice of others, interpret criticism as threat, and frequently become myopic in their views. This narcissistic behaviour fosters hubris. Ranft and Neill state that a board dominated by non-executive directors will guide executive directors through the varied problems a narcissist perspective might cause.

Another group of studies, however, argues that non-executive directors are ineffective monitors. Firstly, many of the non-executive directors are executive directors of other firms. They are busy people and unlikely to become intimately involved in the affairs of the host company (Mace, 1971). Secondly, CEOs are involved in the selection of new non-executive directors. The board may become little more than a 'rubber stamp' which serves only to legitimise executive management decisions because top management both select and dominate the board (Pfeffer, 1972; Shivdasani and Yermack, 1999). Thirdly, the monitoring role depends on the identity of the non-executive directors. Representatives of financial institutions or major customers are likely to have more power than representatives from universities, civil rights groups, or others referred to as 'public' directors (Mizruchi, 1983).

From the above it can be seen that there are two opposite views with regard to the monitoring role of non-executive directors. The related empirical evidence is provided in the following section.

4.2.2.1 Empirical evidence

Direct empirical evidence for the impact of non-executive directors on managerial risk taking is limited. Hill and Snell (1988) is one of the few studies that provide direct evidence. They find that the percentage of outside directors on the board is negatively related to firm R&D expenditure (risk taking), but positively related to firm diversification (risk reduction). This supports the view that non-executive directors can be inefficient in monitoring managers in their risk taking behaviour. Managers prefer reducing firm risk to decreasing their exposure to firm specific risk. When outside directors are selected by inside directors, outsiders are likely to follow insiders' corporate strategy of firm risk reduction.

Hayward and Hambrick (1997) examine how non-executive directors can stop excessive managerial risk taking induced by managerial hubris. Hubris causes managers to over-pay acquisition premiums. Non-executive directors can place more checks on CEO's acquisition decisions and prevent overpayment to the target shareholders. For a sample of 106 large US acquisitions, Hayward and Hambrick report that when the acquirer's board has a high proportion of outside directors, acquirers pay much lower acquisition premiums for targets than when the acquirer board is dominated by insiders.

Sudarsanam and Mahate (2006) examine the impact of non-executive directors on acquirer shareholder value gains through acquisitions. For a sample of 519 UK acquisitions during 1983-1995, Sudarsanam and Mahate find that a high proportion of non-executive directors on the board enhances acquirer shareholder value 3 years after acquisitions.

The above studies show that non-executive directors are effective in disciplining managers' acquisition decisions. Other studies on the effectiveness of board independence report inconsistent results. Weisbach (1988) finds that outsider-dominated boards are significantly more likely to respond to poor performance by dismissing CEOs. This CEO turnover is accompanied by improvements in firm performance (Huson *et al*, 2004). Byrd and Hickman (1992), Bhagat and Black (1999) and Hermalin and Weisbach (2003) report that boards with a higher proportion of independent directors make major decisions that support shareholder interests such as replacing a poorly-performing CEO, consideration of tender offers from other companies that can bring in a better management team than the existing one, and adoption of poison pills[45] to prevent executive directors from selling the company for an unfairly low price. Brickley *et al* (1994) and Cotter *et al* (1997) also find that independent boards are more likely to use resistance strategies such as poison pills to enhance target shareholder wealth in tender offers.

Mehran *et al* (1998) document that the more outside directors a board has, the more likely it is to conduct voluntary liquidation. In liquidation, CEOs forego the present value of future compensation and the consumption of perks in their current firm in exchange for severance pay, and/or compensation from future employment, etc. If the incremental costs to CEOs from liquidation exceed the benefits, CEOs may oppose

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[45] Poison pill is a strategy used by corporations to discourage a hostile takeover by another company. It includes allowing existing shareholders to buy more shares at a discount, allowing shareholders of the target firm to buy the acquirer's share at a discounted price after the merger, etc.

voluntary liquidation even though the liquidation enhances shareholder value. The existence of outside directors can make voluntary liquidations more likely to happen. Uang *et al* (2004) find some weak evidence that the control of non-executive directors makes managers of financially distressed companies report fairly about companies' going-concern status which is bad news for companies and which managers try to cover up.

While the above studies document a positive effect of board independence, other studies provide evidence to the contrary. Baysinger and Butler (1985), Mehran (1995), Yermack (1996), Klein (1998), Agrawal and Knoeber (2001), Bhagat and Black (2002) and Hermalin and Weisbach (2003), all find no relationship between board independence and firm performance measured by Tobin's Q, book-to-market ratio, stock returns, return on equity, return on asset, etc. Core *et al* (1999) do not find that non-executive directors are effective in controlling excessive CEO compensation. Bhagat and Black (1999) even identify a negative correlation between percentage of non-executive directors on the board and firm stock and accounting performance. Hermalin and Weisbach (2003) survey the research on boards of directors in the economic and finance literature. They conclude that board composition as measured by the insider-outsider ratio is not correlated to firm performance as measured by Tobin's Q. Although board actions do appear to be related to board structure, firms with higher proportions of outside directors and those with smaller boards tend to make arguably better decisions, ceteris paribus, concerning acquisitions, poison pills, executive compensation, and CEO replacement, from the perspective that shareholder value can be enhanced.

The above studies are based on US companies. The evidence relating to UK companies is also mixed. Cosh and Hughes (1997) conducted a UK-based study and find that the presence of non-executive directors on the board makes no difference to the level of CEO pay or CEO dismissal, implying that UK non-executive directors only have a transient interest in company affairs and do not engage in designing remuneration packages that align the interests of shareholders and managers, and do not dismiss CEOs who perform badly. For a sample of 460 industrial firms from 1989 to 1996, Dahya *et al* (2002) find that the sensitivity of management turnover to firm performance is significantly stronger following the adoption of the recommendation of Cadbury Report (1992), particularly in firms which increased non-executive directors in line with the recommendation. Dahya and McConnell (2003) investigate UK public company performance changes over the years surrounding the issuance of the Cadbury Report (1992). Using a sample of 1,124 industrial firms listed on London Stock Exchange over the period 1989 -1996, they find that companies that added directors to conform with the Cadbury recommendation (i.e., a minimum number of 3 outside directors on the board) exhibited a significant increase in average return on assets (ROA) of 2.5% from one year before to two years after the adoption. Over the same time interval, the adopting companies' industry peers experienced an insignificant increase in average ROA of just 0.33%.

In contrast, Weir (1997), Weir and Laing (2000), Franks *et al* (2001) and Weir *et al* (2002) do not find that non-executive directors in the UK perform a disciplinary function. Franks *et al* (2001) explain that this is to do with UK regulations. The powers to enforce fiduciary responsibilities on directors in the UK are weak, while in the US, directors have a duty of care to shareholders and can be sued for failing to fulfil their fiduciary responsibilities. Therefore unlike non-executive directors in the US who perform an active governance function, they only perform an advisory role in the UK. It is thus not surprising that the above studies do not find significant corporate control from UK non-executive directors.

Overall the empirical studies are controversial with regard to the effectiveness of non-executive directors' monitoring role on managers. Nevertheless there does exist evidence that non-executive directors can curb managers' excessive risk taking in acquisitions and help create value for acquirer shareholders.

4.2.2.2 Summary

It is suggested that non-executive directors can safeguard shareholder value against managers' self-interest. However, it is also argued that non-executive directors can be ineffective in corporate monitoring because they are under the control of executive directors, because they are far too busy to take care of company affairs, or because who they are, i.e., whether they are a university professor or represent an institutional shareholder. Empirical evidence is mixed. Based on the limited number of studies into the impact of non-executive directors on managerial risk taking, while it is not certain whether non-executive directors can curb managerial risk avoidance, it seems that they can prevent managerial excessive risking induced by managers' behavioural biases.

4.2.3 CEO-COB non-duality

Duality refers to the CEO also holding the chair of the board (COB) position thereby diluting the monitoring and oversight function of the board (Fama and Jensen, 1983; Morck *et al*, 1987). In the UK, the Cadbury Report (1992) on corporate governance has advocated separation of the two roles (i.e., non-duality). Duality impairs the ability of the board to ensure that the firm pursues goals consistent with shareholder value enhancement. Dominant CEOs who are also COBs may be prone to behavioural frailties such as hubris, which may go unchecked by a weak and subservient board. This has been voiced by Benjamin Rosen, Chairman of Compaq. "When the CEO is also chairman, management has de facto control. Yet the board is supposed to be in charge of management. Checks and balances have been thrown to the wind" (Brickley *et al*, 1997, p. 190).

The other perspective is that a combined role of CEOs and COBs gives CEOs more authority to run the company, which in some cases is better for firm management and performance (Ranft and Neill, 2001). Ranft and Neill illustrate this by using CEO-COB conflict in Value America, the Internet superstore. Craig Winn, the founder of the company became the COB and hired Thomas Morgan as the CEO just before the firm's IPO. Winn said that he found it difficult to transfer the decision making power to the new CEO who did not have sufficient knowledge of the new industry. However, Morgan stated that Winn cannot let go of his baby. The company lost millions and the stock value declined. Both Winn and Morgan were replaced. The boardroom fight between the top two decision makers of the firm, CEO and COB, is one of the major reasons for the deteriorating performance of Value America.

4.2.3.1 Empirical evidence

Empirical evidence on CEO-COB nonduality is also mixed. Hayward and Hambrick (1997) and Malmendier and Tate (2004) examine how a non-executive COB can curb a CEO's behavioural biases in the context of corporate acquisitions. Hayward and Hambrick (1997) find that non-duality weakens the relationship between CEO hubris and acquisition premiums paid for targets. Malmendier and Tate (2004) expect that a non-executive chairman can exercise regular checks on a CEO's corporate investment decisions and ensure that CEO proposed acquisitions are less influenced by CEO's overconfidence and therefore may create value for shareholders. For a sample of 477 large US companies from 1980 to 1994, Malmendier and Tate find that separation of the role of CEO and COB is associated with higher acquirer cumulative abnormal returns over (-1, +1) day, day 0 being the acquisition announcement day.

Sudarsanam and Mahate (2006) examine the impact of CEO-COB duality on acquirer shareholder value gains through acquisitions. For a sample of 519 UK acquisitions during 1983-1995, they find that CEO-COB duality only has a weak negative impact on acquirer post-acquisition value creation. Other studies on the concentration of power of CEOs and COBs also report mixed results. Core *et al* (1999) report that duality encourages excessive CEO pay. Examining 1,018 US firms in 1997, Ryan and Wiggins (2004) document that CEOs who are also chairmen are less likely to replace cash pay with equity. They suggest that powerful CEOs use their positions to make their compensation less sensitive to stock price performance and thus put their pay at less risk. Brickley *et al* (1997) examine the impact of duality on company performance. For a sample of 661 Forbes' firms for the 1988 accounting year, Brickley *et al* find that the non duality of CEO and COB has no influence on corporate performance as measured by Tobin's Q, stock returns, return on capital, etc. Similarly, Weir *et al* (2002) and Dahya (2003) also show that the combination of the positions of CEO and chairman has no influence on corporate performance. For a sample of 179 non-financial companies receiving an audit going concern modification[46] in the UK between 30 June 1994 and 3 January 2000, Uang *et al* (2004) find that excessive concentration of power as proxied by the combination of the roles of CEO and COB does not reduce the quality of management reporting of going-concern uncertainties, implying that combing the roles of CEO and COB does not intensify agency problems.

4.2.4 Remuneration committee

A remuneration committee exercises its corporate control function by determining, on behalf of the board and the shareholders, the company's policy on executive remuneration and specific remuneration packages for each of the executive directors (Greenbury Report, 1995; Hampel Report, 1998). Greenbury Report (1995) states that remuneration committees should consist exclusively of non-executive directors who are independent of management and free from any business or other relationship which could materially interfere with the exercise of their independent judgment. Remuneration committees could prevent the tendency of executive management to increase its compensation and/or design compensation contracts that misalign the interests of managers and shareholders.

An alternative view is that remuneration committee could be ineffective due to the control on them by managers (Bebchuk and Fried, 2004, chapter 5 and chapter 6). Managers can exert influence on remuneration committees and distort the compensation process. Managers are involved in the selection of the members of a remuneration committee. The remuneration package set by the remuneration committee is

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[46] Going concern modification indicates company's financial distress and is bad news for a company. Company directors have incentives not to report it fairly.

unavoidably affected by managers' preferences, for instance, for more cash pay but less performance-linked pay, or more stock option grants when the stock market is rising. Bebchuk and Fried state that managers essentially set their own compensation. A compensation package designed in such a way is not likely to align the interests of managers and shareholders.

4.2.4.1 Empirical evidence

Empirical evidence on remuneration committee is limited. PricewaterhouseCoopers conducted a survey in May 1999 to examine the remuneration of UK listed companies' directors. The survey covers companies in the FTSE All-Share Index for financial periods ending between 26 December 1998 and 31 March 1999. The survey finds 281 companies out of 298 (94%) whose remuneration committees are dominated by independent[47] non-executive directors. With such a high compliance with the recommendation of Greenbury Report (1995), the survey implies that remuneration committees should be able to exert an effective monitoring on directors remuneration policy.

Main and Johnson (1993) find that the existence of a remuneration committee is positively related to firm performance. However, Klein (1998) only finds a weak,

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[47] The non-executive director is non-independent if any of the following apply:

- The individual is an ex-employee of the company, another company in the group or a predecessor company;
- He or she works for an advisor of the company;
- He or she has been on the Board for more than nine years;
- Any other material relationship or contract between the non-executive director and company is disclosed.

positive link between these two. Weir and Laing (2000) report some UK evidence from a sample of 200 randomly selected quoted large UK companies each year from 1992 to 1995, they find that the presence of a remuneration committee has a positive effect on firm performance.

4.3 Summary

Corporate monitors such as external blockholdings, non-executive directors, CEO-Chairman non-duality, and the remuneration committees discipline management behaviour, and ensure that managers take corporate actions to maximise shareholder value. In the case of managerial risk taking, efficient corporate monitors should curb both managerial risk avoidance and excessive managerial risk taking induced by behavioural biases. This chapter presents the theoretical arguments as well as the empirical evidence on how each of these monitors plays a monitoring role and how effective the monitoring is.

It is arguable whether or not external blockholders as well as institutional investors provide efficient monitoring of managers' behaviour. Empirical studies into the impact of external blockholders on managerial risk taking, value creation of acquisition, and various other firm behaviours show a mixed result. It is also controversial as to whether or not a board with a high proportion of non-executive directors can be a more effective monitor than a board with a low proportion of non-executive directors. No consistent conclusion has been drawn on the impact of the combination of the role of Chief Executive Officer and Chairman of Board on managerial risk taking or shareholder value. While some studies report that the remuneration committees help improve firm performance, others state that they simply become a 'rubber stamp' under the control of top managers. Overall, existing corporate governance literature does not show with any certainty that any of the four corporate monitors discussed in this chapter play a disciplinary role on management behaviour. Thus more empirical studies are recommended.

Chapter 5

Determinants of Acquisition Risk and Post-acquisition Performance: Research Questions and Hypotheses

5.1 Introduction

The previous three chapters discuss the theories and empirical evidence related to managerial risk taking. Combining the traditional agency literature and behavioural agency literature, the thesis identifies three major factors that affect managers' risk preferences. They are the components of managerial wealth portfolio, behavioural biases and corporate monitoring mechanisms. These factors are discussed separately in Chapter 2, 3 and 4. Their impact on managerial risk taking is illustrated in Figure 1-1 in Chapter 1.

During this review process it became apparent that the research on the determinants and performance consequence of managerial risk taking is quite limited. Traditional agency studies only assume that managers are risk avoiders and try to suggest incentive plans to drive managers to conduct risky projects to maximise shareholder value. On the other hand, the behavioural agency literature criticizes the risk assumption for managers in the traditional agency model as being far too restricted. Managers can be risk seeking as well as risk averse. Therefore, the behavioural theorists ignore the solutions proposed by the traditional agency model and suggest that traditional agency studies are not able to solve the puzzle of managerial risk taking since the model assumption is not correct. However, no empirical studies have integrated these two views in one model to comprehensively analyse the determinants of managerial risk taking. This literature gap along with other issues that have been neglected by the existing literature will be discussed in section 5.2. Two research questions are raised in Section 5.2, the first relates to an examination of the determinants of managerial risk taking, and the second relates to associating firm performance and managerial risk taking.

Acquisitions are used as a context for the investigation of managerial decision-making. The different risk profiles associated with high-tech acquisitions as compared to low-tech acquisitions are described in Section 5.3. In accordance with the research questions and the discussion of the risk profile of acquisitions, Section 5.4 hypothesizes the relationship between acquisition risk and various managerial wealth components. The hypothesized relationships between acquisition risk and managers' behavioural biases are presented in Section 5.5. Section 5.6 covers the postulated association between acquisition risk and various corporate monitors. Summarising all the above hypotheses, Section 5.7 reports the conceptual model of managerial risk taking presented in this thesis. Section 5.8 postulates on relationship between acquirer's post-acquisition performance and the risk level of acquisitions, and describes the performance model presented in this thesis. Section 5.9 is the chapter summary.

5.2 Literature gap and research questions

Chapter 2 reviews the literature written on the impact of the components of managerial wealth portfolio on managers' risk incentive as well as managerial risk taking. Chapter 3 presents the view of how behavioural biases such as overconfidence, over-optimism and hubris, can drive managers to conduct excessive risk taking resulting in shareholder value loss. Chapter 4 shows how corporate monitors can discipline managers' suboptimal corporate behaviours or align their behaviour with shareholder interests. Summarising the studies in those three chapters, this section discusses the apparent literature gap in the field of managerial risk taking.

In traditional agency studies managers are assumed to be risk averse. Wealth incentives such as compensation contracts including LTIP share awards, stock options, and equity ownership are provided to managers to reduce their degree of risk avoidance. However, evidence is inconclusive as to whether or not any of these incentive plans are effective in aligning the interests of managers and shareholders. Depending on the payoff structure, these incentive plans can have different impacts on managers risk attitudes. The behavioural agency literature argues that the risk assumption for managers in the traditional agency model is far too restricted. Managers can be risk seeking as well as risk averse. Managerial behavioural biases which may be encouraged by managers' good past performance or media praise can lead to excessive managerial risk taking resulting shareholder value loss. These managerial behavioural biases however are not considered by the traditional agency studies which examine the determinants of managerial risk taking behaviour. Corporate monitors such as external blockholders, non-executive directors, and remuneration committees are suppose to discipline managers and make sure that managers take neither too much nor too little risk. Studies of the impact that corporate control devices have on managerial risk taking are few.

Taken together, no empirical studies has incorporated the views of traditional agency theory and behavioural agency theory into one model and conducted a comprehensive study of managerial risk taking. The question of what drives managers to take risk remains a puzzle in the empirical literature. This is what this thesis aims to explore. The first research question is as follows:

Q1: What are the factors that drive managers to undertake risky projects?

This question will be answered mainly from the perspective of managerial wealth, behavioural biases, and corporate monitoring mechanisms. The major difference between this thesis and the other studies on managerial risk incentive is that this thesis does not restrict its assumption on managers' risk attitudes. Managers can be risk averse, risk neutral or risk seeking. Their risk preferences are affected by their wealth portfolio, their psychological biases, and corporate control devices. A relaxed assumption regarding managerial risk attitude can better explain firm's business behaviour.

A proxy for risky projects is needed in order to answer research question Q1. Section 2.5 of Chapter 2 has summarised the major proxies for managerial risk taking in the existing literature. They can be mainly categorised into firm risk (an *ex post* measure) and investment risk (an *ex ante* measure). Firm risk is measured by firm stock return volatility, book-to-market ratio, analysts' forecast of earnings per share, etc. Investment risk is measured by corporate risk diversification, corporate hedging, R&D investment, oil & gas exploration activities, etc. As discussed in Section 2.5 of Chapter 2, an *ex ante* measure is superior to an *ex post* measure because the latter is not a direct measure of managerial risk taking while the former is. An *ex post* measure captures some other events that occur after managers' investment decisions have been executed while an *ex ante* measure such as investment risk directly reflects managers' choice of project risk. Therefore, this thesis employs an *ex ante* measure of investment risk, managers' choice of high-risk, high-tech acquisitions as a proxy for managerial risk taking.

Acquisitions are large and visible corporate investments that can significantly alter acquirer risk profiles (Smith and Triantis, 1995). They accentuate agency conflicts more than other internal capital investment projects such as R&D investment because acquisitions involve much more time, people and corporate resources than any other internal capital investments. Acquisitions generally require the active participation of all decision makers, namely, managers, directors and shareholders. Managers usually negotiate acquisitions, directors have to endorse them and are sometimes involved in the negotiations, and shareholders have to vote on them. There exists significant divergence of interests among these parties regarding acquisition decisions. Shareholders would like managers to conduct acquisitions that yield synergies and create firm value (Manne, 1965; Sudarsanam, 2003, Chapter 4). Managers may pursue size via acquisitions in order to accelerate their wealth accumulation, secure their jobs and increase their power but at the cost of shareholders (Firth, 1980; Jensen, 1986). Managers may spend corporate resources to buy rapidly growing companies to create attractive job opportunities for young managers and to assure the survival of the company regardless of whether the acquisitions can bring value to shareholders or not (Shleifer and Vishny, 1989; Morck *et al*, 1990). Boards of directors representing shareholders try to control managers' pursuit of self-interest and to ensure that acquisition decisions are in line with shareholder value enhancement (Sudarsanam *et al*, 1996). Acquisitions therefore are a suitable context in which to examine the conflict of interests among managers, shareholders, and boards of directors.

While diversifying acquisitions are thought to be driven by managerial preference for risk reduction (Amihud and Lev, 1981; Amihud *et al*, 1986; May, 1995), acquisitions of targets rich in intangible assets such patents or R&D, obviously ratchet up the risk faced by the acquirers (Kohers and Kohers, 2001). The background of high-tech acquisitions as well as the reasons why they are riskier than low-tech acquisitions are discussed in the next section. There is extensive evidence that acquirer firm shareholders do not gain from acquisitions in the short term and experience value losses in the longer term (Agrawal and Jaffe, 2001; Sudarsanam, 2003, chapter 4; Moeller *et al*, 2004). Whether such value losses are due to skewed risk incentives that managerial wealth components provide or are encouraged by behavioural biases such as overconfidence, over-optimism, or hubris is an interesting question to resolve empirically. In this thesis therefore acquisitions are considered to be an appropriate corporate decision-making context in which to explore the relationship among wealth, behavioural biases, monitoring mechanisms, investment risk profile, and shareholder value gains. Corresponding to research question Q1, Section 5.4 to Section 5.6 propose specific hypotheses which are subsequently tested in this thesis.

So far the first research question has been raised and the context in which investigate this question has been discussed. The second step is to examine the performance consequence of managerial risk taking. This investigation is usually neglected in traditional agency studies. Traditional agency theorists consider managerial risk aversion to be the norm, managerial risk taking is always regarded as an activity that can reduce the principal-agent conflicts arising from such risk aversion, and consequently increase firm value. See Section 2.5 of Chapter 2 for a detailed discussion of this issue. This thesis allows for both managerial risk aversion and managerial risk seeking. High-risk projects brought about managerial behavioural biases can cause shareholder value destruction just as low-risk investments undertaken due to managerial risk avoidance. This highlights the importance of examining the relationship between managerial risk taking and subsequent firm performance and implies that an optimal-risk project that can maximise shareholder value can neither be at too high risk nor at too low risk to the firm. It is therefore necessary to identify the level of suboptimality of investment project risk and to investigate the association between firm performance and the level of suboptimality of the project. This is not examined in the existing literature. The second research question therefore is:

Q2: To what extent is firm performance related to the optimal or suboptimal risk level of an investment project?

In the case of acquisitions, research question Q2 relates to an exploration of the association between acquirer post-acquisition performance and the optimality/suboptimality of acquisition risk. To investigate this relationship, the first step is to determine the optimal risk level of acquisitions. However, none of the existing theoretical models provides a formulation of the optimal risk level of an investment project which combines the perspectives of the traditional agency, behavioural agency, and corporate governance frameworks. This thesis aims to establish an empirical risk model to predict such a level. The model is introduced in Section 6.5 of Chapter 6. Specific hypotheses corresponding to research question Q2 are presented in Section 5.8.

Before any hypotheses regarding acquisition risk are provided, the next section first discusses the risk profile of high-tech and low-tech acquisitions.

5.3 Risk profile of high-tech acquisitions

The fifth merger wave in the USA and the parallel fourth merger wave in the UK that occurred between 1993 and 2000 was characterised by a large number of acquisitions of firms operating in high-tech areas such as the telecommunications, computers, the internet, biotechnology, etc. A common characteristic of those industries is that they often reflect young, emerging industries that have a high level of intangible assets and focus on the development of new and innovative technology within their respective areas (Ittner *et al*, 2003). Saura Diaz and Gomez-Mejia (1997) based on the assessment of several researchers summarise the unique features of high-tech firms. In brief, they are as follows:

1. Tasks are highly uncertain and tend to have a long time horizon.
2. Research projects, as well as business plans, may have to be altered overnight as a result of a new product release.
3. There is a need to channel resources to R&D, the core function of the firm, and to reduce expenditures in other areas.
4. There exists high outcome uncertainty given the difficulty of establishing unambiguous cause-effect linkages between R&D and products.
5. Whether or not technical success will lead to commercial success is uncertain at best, with most patented inventions failing to generate sufficient revenues to cover the development costs.
6. Firms are willing to take risk and have a high tolerance for ambiguity.
7. Firms promote entrepreneurial activities and have a high tolerance for failure.

Acquisitions of such high-growth companies may enhance the capabilities of the acquirer to move into a new growth area and achieve technological breakthroughs and thereby gain sustainable competitive advantage. Such acquisitions are called 'high-tech acquisitions' (Kohers and Kohers, 2001). High-tech acquisitions are in nature similar to a growth option, i.e., "an early investment (e.g., R&D, lease on undeveloped land or oil reserves, strategic acquisition, information network/infrastructure) is perquisite or link in a chain of interrelated projects, opening up future growth opportunities (e.g., new generation product or process, oil reserves, access to new market, strengthening of core capabilities)" (Smith and Triantis, 1995, p. 4). If the post-acquisition integration is successful, the enhanced resources and capabilities of the merging firm may create many more growth opportunities, e.g., to develop new generations of products or processes, the potential to access new market niches.

However purchasing high-tech firms is also associated with high-risk and is vulnerable to failure (Bannert and Tschirky, 2004). Firstly, the scope for estimation error is large. Serious information asymmetry exists in intangibles-intensive companies between insiders and outsiders (Lev, 2001). This increases the difficulty for target identification, valuation and post-acquisition integration. To make things worse, it is reported that technologists are rarely involved in the valuation process (James *et al*, 1998).

Secondly, some studies have reported that acquisitions undermine the development of technology capabilities by diverting resources and management attention away from the existing business (Hitt *et al*, 1991; Chakrabarti *et al*, 1994; Gerpott, 1995; Hitt *et al*, 1996; James *et al*, 1998). Dyer (2002) analyses the performance of GlaxoSmithKline (GSK) following the merger in 2000 and reports that research often grinds to a halt when mergers are announced because people wonder if they will have a job and if their projects will be continued. GSK has lost probably around five years' research time due to a series of merger activities and four out of twelve top scientists in their R&D group have left since the merger in 2000. The company seems to have suffered greatly from faltering innovation.

Thirdly, uncertainty exists as to whether or not the acquired technology can lead to a commercially successful product or service. Many of these high-tech firms pursue untested products, markets, and business models. Hence, more uncertainty and longer investment horizons characterize the growth opportunities of high-tech firms and the payoffs from technology investments are often highly negative (Chan *et al*, 2001; Kothari *et al*, 2001).

Low-tech acquisitions, i.e., acquisitions of low-tech firms, are far less risky than high-tech acquisitions. Low-tech firms such as those in the retail industry primarily invest in real assets (e.g., infrastructure and inventory). This results in observable performance benchmarks (for instance, inventory turnover) that are relatively easy to estimate. Acquisitions of such firms are much easier to value and the integration process is more controllable than acquisition of high-tech firms. Let's compare buying a supermarket with buying a software firm. The former is a low-tech acquisition and the latter is a high-tech acquisition. The performance of a supermarket is much more predicable than the performance of a biotechnology firm. It is because the sales of a supermarket rely on consumer demand and do not fluctuate dramatically year-by-year whereas it is hard to tell whether or not the software under development in a software firm will have a commercial success. In the software firm, employees are encouraged to generate new ideas to develop new software to gain more market share. In the supermarket, inventory turnover is one of the important performance criteria. The faster the turnover, the more goods are sold and the better the sales. Therefore, there are more entrepreneurial activities in software firm than in a supermarket. The value of a software firm relies on new products generated by technical expertise. This creates difficulty in post-acquisition integration because this expertise may leave the company and take away the core assets of the target firm if the leavers do not like the culture of the acquiring firm. This is less likely to happen with buying a supermarket because its core asset is the stores. Therefore buying a software firm poses more challenges in target valuation and post-acquisition integration to acquirers than does buying a supermarket.

Harrison (2000) illustrates how a low-tech firm could be different from a high-tech firm by comparing a firm in the commodity chemicals sector to a firm in the life sciences sector. The former is a low-tech firm while the latter is a high-tech firm. The commodity chemicals sector is a traditional and mature business segment with a low level of growth. Acquisitions in commodity chemicals mainly aim to achieve economies of scale by increasing acquirer firm capacity. Life sciences however, such as pharmaceuticals, biological products, diagnostic substances, nutritional substances, and crop protection products, enjoy the prospect of high levels of long-term growth. Acquisitions in this segment mainly aim to access new technology, products or processes which are not easily duplicable or may be shielded by patents.

In summary, although high-tech acquisitions may bring acquirers substantial benefits when successful, to achieve success is difficult. The combination of acquisition-related risks and intangibles-related risks create a unique risk profile for such acquisitions, making them far riskier than low-tech acquisitions. The following three sections hypothesize the relationship between acquisition risk and each of the incentive drivers as discussed in the last three chapters.

5.4 Wealth incentives

This section presents the hypotheses for the relationship between acquisition risk and each component of managerial wealth portfolio.

5.4.1 Fixed compensation and annual bonuses

As discussed in Section 2.3.2.1 of Chapter 2, fixed compensation does little to incentivise managers to overcome their risk aversion. A high level of such compensation creates the incentive for managers to avoid risk and protect their existing income. Buying a high-tech firm is risky for the acquirer. The bidder manager must exert extra effort to obtain more information about the target before the deal in order to reduce the risk associate with the acquisition. Even if the manager has succeeded at this stage, it is not certain whether or not the target technology can be successfully transferred to the acquirer and lead to a commercially successful product or service.

An acquisition failure may damage the acquiring managers' career progress and future income. This can be illustrated by the $183 billion[48] merger between Internet giant American Online (AOL) and media conglomerate Time Warner in 2000. The logic behind this merger is that Time Warner, the traditional media company in radio, cable television and publishing, could utilise the technological savvy of AOL to expand their media business into a new area, online media services, and AOL could have access to Time Warner's 21 million cable customers and the broadband system (Badakhshan *et al*, 2005). This union would allow both companies to increase their customer bases and enhance their market shares. However, one year after the deal, the merged company AOL Time Warner wrote off $54 billion. Three and a half years after the merger in 2003, the firm dropped 'AOL' from its name, indicating the reversal of the mega-merger. One of the reasons for this merger failure is that there was a wrong estimation

[48] This value is based on the day when the merger was made public.

of the technology capabilities Time Warner could offer to AOL[49]. The chairman of the merged company, Mr Steve Case, who was seen as the driving force behind the merger, stepped down in May 2001, following pressure from shareholders (BBC News, 13 January 2003).

Fixed compensation is unlikely to motivate managers to seek high-risk high-tech acquisitions which can put managers' stable income, reputation and future careers at risk. It appears that fixed pay can only intensify managerial risk avoidance and make them avoid high-risk acquisitions.

As addressed in Section 2.3.2.2 of Chapter 2, an annual bonus scheme gives a manager the incentive to turn down a positive NPV project with a long payback period. Tehranian *et al* (1987) give an illustration using a merger as an example. When a firm with great marketing resources acquires a small firm owning a patent relating to the development of a positive NPV product, high development expenses in the early years of the product's life imply that short-term profits will be low. Such a merger could be turned down by 'quick profit' oriented managers. This cash flow pattern is typical of investment projects in high-tech companies. Buying such companies means that the acquiring managers have to accept long payback horizons and uncertainty in realizing the targets' growth opportunities. This however, does not match the short-term nature of the annual bonus. Hence, managers with a high level of annual bonus are not likely to select high-risk targets for acquisitions.

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[49] Time Warner's broadband system was relatively geographically limited and its infrastructure of the cable network did not allow for easy expansion of coverage. Thus AOL could not get what it expected from the merger.

In light of the above, it follows that there exists a negative relationship between cash compensation (i.e., fixed compensation and annual bonus) and the riskiness of acquisitions pursued by managers. Therefore it is hypothesized that:

H1: Acquisition risk is negatively related to the level of cash compensation, i.e., fixed compensation and annual bonus.

5.4.2 Equity-based managerial wealth components

The arguments for the relationship between managerial risk taking and equity-based wealth are provided in Section 2.3 of Chapter 2. The measures for the incentive provided by equity-based wealth, delta and vega, are discussed in Section 2.3.3 of Chapter 2. In summary, existing compensation literature suggests that the incentive from the pay-performance relationship, i.e., equity delta, is nonlinear. At a low level, equity delta (or LTIP delta, option delta, share delta) aligns the interests between managers and shareholders. Therefore equity delta (or LTIP delta, option delta, share delta) will encourage managers to take more risky projects to increase firm value. However, when the delta value is high, it exposes managers' wealth to more firm-specific risk. This increases managerial risk aversion to high-risk projects.

Based on the above argument, it is expected that a small delta can drive managers to undertake risky acquisitions since managers can benefit from the success of the acquisitions, whereas acquisition failure will not make managers lose a significant amount of personal wealth. However, as the magnitude of the delta gets bigger, managers' wealth is more vulnerable to acquisition failure. This will make managers more cautious in choosing risky acquisitions. Therefore, it is hypothesized that:

H2: There is a concave relationship between acquisition risk and the level of equity delta.

Both the theoretical arguments and empirical evidence discussed in Section 2.3.2.4 and Section 2.3.4.2 of Chapter 2 suggest that stock options encourage managerial risk taking. This is mainly attributed to the convexity (i.e., vega) of the stock options. Stock option vega can eliminate managers' concern about the downside risk of risky acquisitions since managers' wealth is protected from the failure of the acquisitions but increases with the stock price gains brought by the acquisitions. Therefore, stock option vega is expected to encourage managers to take risky acquisitions. It is hypothesized that:

H3: Acquisition risk is positively related to the level of stock option vega.

According to the literature review in Section 2.4.2 of Chapter 2, managers' risk attitude varies when they are at different wealth levels. As managers' wealth increases, they do not have much of an appetite for high risk projects that may yield high returns because the marginal utility of any increase in wealth is diminishing. Therefore when managers are very wealthy they are not keen to take high risk. If managers have a large amount of wealth attached to their employer firms, managers, who do not want to put their wealth at risk, are risk averse to firm-specific risk, and therefore may avoid risky projects. Overall, a high level of managerial wealth does not encourage managerial risk taking. This study uses managers' wealth attached to their firms to proxy for managers' total wealth because it is impossible to obtain data for managers' wealth invested outside of their firms. A high level of managerial wealth intensifies managerial risk aversion to their firm risk. This risk aversion effect can diminish the incentive alignment effect from delta or vega and make managers less likely to undertake risky acquisitions[50]. Therefore, it is hypothesized that:

H4: Acquisition risk is not positively related to equity delta at a high level of managerial wealth.

H5: Acquisition risk is not positively related to stock option vega at a high level of managerial wealth.

5.4.3 LTIP cash

According to Chapter 2, there exist few theoretical arguments and very little empirical evidence proving any kind of incentive effect from LTIP cash. Given that LTIP cash is one of the long-term incentive plans with investment horizons of at least three years and with performance thresholds, managers need to invest in growth-oriented risky projects to improve firm performance in order to obtain the rewards from LTIP cash. Unlike LTIP shares which expose managerial wealth to 100% of firm risk, LTIP cash awards do not introduce such high risk to managers' wealth and therefore will not intensify managerial risk aversion as LTIP shares do. In the case of acquisitions, LTIP cash is expected to encourage managers to pursue risky acquisitions so that firm performance can meet the performance thresholds set in the LTIP cash rewards and managers can then obtain their rewards. Therefore, it is hypothesized that:

H6: Acquisition risk is positively related to the level of LTIP cash.

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[50] The above argument also suggests that acquisition risk is negatively related to the level of managerial wealth. The reason why this thesis does not develop a hypothesis for wealth is that it is impossible to test this hypothesis using the sample data of this study. The major component of wealth is managerial equity holdings. As discussed in Section 7.4 of Chapter 7, the wealth variable is highly correlated to the equity variable.

5.4.4 Summary

Section 5.4 presents the hypotheses for the relationship between the riskiness of acquisitions pursued by managers and the components of managerial wealth portfolio. Collectively, Section 5.4 predicts a negative relationship between acquisition risk and the level of fixed compensation and annual bonuses, and predicts a concave relationship between acquisition risk and the level of equity delta (or LTIP delta, stock option delta, share delta).

It predicts a non-positive relationship between acquisition risk and the level of the following:

- equity delta (or LTIP delta, stock option delta, share delta) at a high level of managerial wealth
- stock option vega at a high level of managerial wealth

It predicts a positive relationship between acquisition risk and the level of the following:

- LTIP cash
- stock option vega

5.5 Behavioural biases

Chapter 3 illustrates that behavioural biases such as overconfidence, hubris and over-optimism which cause many managers to overestimate their ability and underestimate acquisition risk, lead to acquirer shareholder value destruction. As discussed in Section 5.3, an acquisition of a high-tech target is similar in nature to a growth option, i.e., it is associated with considerable uncertainty and the need to take a view of the future. If a high-tech acquisition is successful, it allows the acquirer to quickly transfer the target's technology to itself and rapidly gain market power. Aware of the challenges and substantial benefits embedded in high-tech acquisitions, managers with hubris are particularly attracted to such acquisitions because they provide them with greater opportunities to demonstrate their capability in 'creating miracles', i.e., they can successfully complete high-tech acquisitions and realise the great benefits embedded in the acquisitions (Kohers and Kohers, 2001). Thus in environments characterised by optimism, as was the case during the dotcom bubble of the 1990s, many high technology acquisitions may have been driven by managerial over-optimism, overconfidence and hubris. These biases may have compounded the problem of valuation risk associated with high-tech acquisitions leading to overpayment for targets and to acquirer shareholder value losses.

The case of Vivendi illustrates such adventurous tendencies (Johnson and Orange, 2003). Vivendi was originally in the water supply and sewage treatment business in France and was struggling with financial difficulties. Jean-Marie Messier successfully turned the firm around. He was, however, not satisfied with the humble, down-to-earth business of Vivendi but was excited by high-tech businesses. Therefore, he transformed the company through a succession of acquisitions into an international high-tech conglomerate engaged in activities such as fibre optic cable manufacture, cable television, mobile telephony, and the running of movie studios. He was granted the title of the 'perfect Frenchman' by the French media. However, after the telecom bubble burst in 2000, Vivendi fell into substantial financial difficulties. Jean-Marie Messier was sacked and convicted of fraud. Johnson and Orange comment that "Without his (Jean-Marie Messier's) vision and personality – a strange blend of French technocratic arrogance, wannabe Hollywood showmanship and investment banker charm – Vivendi Universal would never have come into existence. Without Jean-Marie Messier's weakness – a love of deal-making, self-promotion, obfuscation and risk – the dream of a French champion might have survived" (Johnson and Orange, 2003, p. 3).

Another example is Jack Welsh, the CEO of General Electric (GE) for around twenty years. GE is a conglomerate with businesses from jet engines to power generation, financial services to plastics, and medical imaging to news and information. In his book of 2001, Jack Welsh describes that his decision to acquire Kidder, Peabody in 1986 was affected by hubris. Kidder, Peabody was one of the Wall Street's oldest investment banking firms. Buying Kidder was opposed by three GE board members who warned that Kidder's business was far too different from GE and the acquisition was far too risky. However, encouraged by his success of past acquisitions, Jack Welsh deeply believed that he could make anything work. Eight months after the acquisition, he regretted his decision. The top management of Kidder was charged with insider trading and was arrested. As the new owner of Kidder, GE was saddled with the legal responsibility. "There's only a razor's edge between self-confidence and hubris. This time, hubris won and taught me a lesson I'd never forget", says Jack Welsh (Welsh, 2001, p. 229).

Based on the above arguments, it is expected that there exists a positive relationship between acquisition risk and managerial behavioural biases such as overconfidence, over-optimism and hubris. As discussed in Section 3.2 of Chapter 3, the boundaries between these three types of behavioural bias are blurred. However all of them cause managers to overestimate their abilities and underestimate investment risk. Therefore, this thesis uses the term 'behavioural biases' to capture this common characteristic of these three behavioural biases. It is hypothesized that:

H7: Acquisition risk is positively related to behavioural biases.

5.6 Monitoring mechanisms

This section presents the hypotheses for the relationship between acquisition risk and monitoring devices such as external blockholders, institutional blockholders, board independence, non-duality of CEO and COB, and remuneration committees.

5.6.1 External blockholders

Section 4.2.1 of Chapter 4 suggests that external blockholders have strong economic incentives to undertake effective monitoring. In the case of high-risk acquisitions, large outside shareholders can force acquirer managers to examine carefully their acquisition strategies. Managers will have to conduct more scenario analyses corresponding to the uncertainties embedded in high-risk acquisitions. They will have to exert more effort and spend more time estimating and reducing the downside risk associated with the acquisitions. As a result, management forecasts of acquisition synergies are likely to be less optimistic than when there is no control from external blockholders. The same logic applies to institutional blockholders. As discussed in Section 4.2.1 of Chapter 4, institutional shareholders have more incentive to monitor management than the other types of external shareholders because institutional shareholders are collectively the largest owners of shares in the UK and US. Overall, it is expected that external blockholders as well as institutional blockholders may cure the excessive risk-seeking problem demonstrated by overconfidence/over-optimism/hubris stricken managers. On the other hand, they can also fine-tune their monitoring to ensure that managers do not pass up valuable but nonetheless high risk acquisitions because of managerial risk aversion. Thus it is expected that strict large external shareholder monitoring can help ensure optimal risk acquisitions. Therefore, it is hypothesized that:

H8: the higher the level of external blockholdings, the more likely the acquisition risk is at an optimal level.

5.6.2 Board composition

Section 4.2.2 of Chapter 4 presents the views on board composition. In the case of acquisitions, non-executive directors are certain to be involved in the approval of such attempts. They are likely to be more objective in evaluating the costs and benefits of an acquisition than the executive directors who propose the takeover. The objectivity of outside directors is particularly important in monitoring the acquisition process when managers' empire-building ambitions or hubris conflicts with shareholder interests. Non-executive directors can monitor managers' tendency towards over-risk or under-risk investment arising from their risk attitudes and wealth incentives. A board with a high proportion of non-executive directors is likely to monitor acquisitions robustly and ensure that they create shareholder value. Therefore it is expected that a high proportion of non-executive directors will have a positive impact on aligning shareholder and managerial risk preferences and will be likely to discourage suboptimal risk taking and thereby ensure that acquisitions have an optimal risk profile that enhances shareholder value. Consequently, it is hypothesized that:

H9: The higher the proportion of non-executive directors on the board, the more likely the acquisition risk is at an optimal level.

5.6.3 Non-duality

As discussed in Section 4.2.3 of Chapter 4, duality, i.e, the combination of the roles of CEO and COB, impairs the ability of the board to ensure that firms pursue goals consistent with shareholder value enhancement. Dominant individuals who hold both CEO and COB positions may also be prone to the behavioural frailties such as overconfidence, over-optimism, or hubris if unchecked by a weak and subservient board. Therefore, it is expected that CEO-COB non-duality will have a positive impact on aligning shareholder and managerial risk preferences. Such alignment of goals will help managers select acquisitions of optimal risk levels that maximize shareholder value. Consequently, it is hypothesized that:

H10: When there is non-duality of CEO and COB, it is more likely that the acquisition risk is at an optimal level.

5.6.4 Remuneration committee

As discussed in Section 4.2.4 of Chapter 4, remuneration committees design compensation contracts that align the interests of managers and shareholders and prevent the tendency of executive management to 'grow' their own compensation packages. As discussed in Section 2.3 and Section 2.4 of Chapter 2, an excessive grant of cash compensation can make managers more risk averse, whilst an excessive grant of stock options can induce managerial excessive risk taking. A remuneration committee comprised of non-executive directors who are independent of management could set executive compensation at a level so as to encourage managers to conduct optimal-risk projects. Therefore, it is expected that the presence of remuneration committees on company boards will have a positive impact on managers' selection of acquisitions that aligns shareholder and managerial risk preferences. It is hypothesized that:

H11: When there is a remuneration committee of the company board, it is more likely that the acquisition risk is at an optimal level.

5.6.5 Summary

Section 5.6 hypothesizes that external blockholders, institutional blockholders, board composition of non-executive directors, CEO-COB non-duality and the existence of a remuneration committee can all induce optimal risk acquisitions that maximise shareholder value.

5.7 A conceptual model of managerial risk taking

Based on the above discussions, the following conceptual model of managerial risk taking is formulated:

$$Acquisition\quad risk = f(Wealth, Behavioural\quad biases, Monitors) \qquad \textbf{Model 5-1}$$

where *Acquisition risk* is the risk level of an acquisition; *Wealth* constitutes the bundle of various managerial wealth elements including fixed compensation and annual bonuses, LTIP cash, LTIP shares, stock options and managerial shareholdings; Behavioural biases refer to managerial overconfidence, hubris and over-optimism; *Monitors* include external block shareholding, institutional blockholding, board composition of non-executive directors, CEO-COB non-duality and the presence of a remuneration committee on the board. An empirical risk model containing all of these variables and some control variables is discussed in Section 6.5.1 of Chapter 6.

5.8 Acquisition risk and post-acquisition performance

Model 5-1 builds a conceptual model of 'optimal-risk' acquisitions as a function of managerial wealth incentives, behavioural biases and corporate monitoring mechanisms. If all the empirical corporate governance devices are optimal and effective[51], the acquisition risk level predicted by this model should be the optimal level that maximises shareholder value for each investment project. Any acquisitions risk that deviates from the predicted level is 'suboptimal'. The level of 'suboptimality' has a negative impact on acquirer post-acquisition performance and hence shareholder value.

In the case of 'under-risk' investment (i.e., the actual risk level of an acquisition is lower than the predicted one), managers pass up the opportunities of investing in a more profitable positive NPV project. Persistently passing up risky acquisitions would make those firms gradually lose competitive advantage to their competitors. Over the long run, these firms will have poor profitability and underperform their competitors. Evidence of value destruction from low risk diversifying acquisitions is consistent with this argument (Amihud and Lev, 1981; Rajan *et al*, 2000; Graham *et al*, 2002).

'Over-risk' investment (i.e., the actual risk level of an acquisition is higher than the predicted one) is like gambling. While high return projects are likely to be risky, high-risk projects do not necessarily yield high returns. This latter is particularly true when managers choose high-risk acquisitions only because managers underestimate the

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[51] There may exist some other factors influence managers' choice of risky projects. In the empirical risk model discussed in Section 6.5.1 of Chapter 6, some of these factors are included. I acknowledge that there may exist some other factors that are not included in the empirical risk model (see Section 9.2 of Chapter 9.4 of Chapter 9). This will be an area for future research to enhance the rigor of the empirical risk model.

risks embedded in those acquisitions. Empirical evidence presented in Chapter 3 suggests that such acquisitions destroy shareholder value (Roll, 1986; Berkovitch and Narayanan, 1993; Hayward and Hambrick, 1997; Kohers and Kohers, 2001; Hletala *et al.* 2003).

It is therefore expected that, both types of suboptimal risk investment will lead to acquirer shareholder value destruction and underperform the optimal risk investment group. The hypothesis is as follows:

H12: Both under-risk and over-risk acquisition lead to negative post-acquisition performance.

The relationship can be formulated in the following conceptual performance model (Model 5-2).

$$Post-acquisition \quad Performance = f\begin{Bmatrix} Optimal-risk & acquisition & (+) \\ Under-risk & acquisition & (-) \\ Over-risk & acquisition & (-) \end{Bmatrix} \quad \textbf{Model 5-2}$$

The signs indicate that optimal-risk acquisitions can increase shareholder value. Both under-risk acquisitions and over-risk acquisitions may destroy shareholder value. Post-acquisition performance is negatively associated with the degree of suboptimality of acquisition risk. The performance model establishes an association between firm performance and managerial risk taking resulting from the joint impact of the various drivers embodied in the conceptual risk model (Model 5-1). The empirical performance model containing the defined variables for the conceptual model (Model 5-2) and some control variables is presented in Section 6.5.4 of Chapter 6.

5.9 Summary

This chapter identifies the literature gap, raises research questions and develops two conceptual models, the risk model (Model 5-1) and the performance model (Model 5-2). This chapter interprets the pursuit of risky acquisitions such as buying high-tech targets as a manifestation of managerial risk preference. This chapter also develops hypotheses regarding the relationship between acquisition risk and the various drivers for managerial risk taking such as managerial wealth incentives, behavioural biases and corporate monitors, and thus formulates the conceptual risk model (Model 5-1). This conceptual model is then translated into an empirical model for predicting 'optimal-risk' or 'suboptimal-risk' acquisitions. The empirical model will be discussed in Section 6.5.1 of Chapter 6. Any deviation from the predicted level, i.e., 'suboptimal-risk' acquisitions will cause acquirer shareholder value destruction as predicted by the performance model (Model 5-2). These two models thus establish a relationship between firm performance and managerial risk taking resulting from the joint impact of the various risk incentive drivers derived from managerial wealth, behavioural biases, and corporate monitoring mechanisms.

Chapter 6

Data, Methodology and Other Related Issues

6.1 Introduction

This chapter resolves a number of issues relating to the data and methodology issues used in the analysis in later chapters of this thesis. Section 6.2 lists and defines the variables in the empirical risk model and the empirical performance model which are presented in Section 6.5. The data sources are presented in Section 6.3. The sample selection criteria are addressed in Section 6.4. Section 6.5 lays out the methodology comprising five steps analyses. All the relevant statistical analyses and event study related methodology are explained in this section. The proposed empirical risk and performance models are based on the conceptual models of Chapter 5 (see Section 5.7 and 5.8 of Chapter 5) and the variable definitions in Section 6.2. Section 6.6 provides the chapter summary.

6.2 Data

This section lists and provides definitions for the variables in the empirical risk model (Model 6-1) and the empirical performance model (Model 6-4)[52]. A summary of all of the variables is listed in Table 6-5. In addition to the factors such as managerial wealth, behavioural biases and corporate monitors that are discussed in the conceptual models, a number of other factors shown as control variables are added to both the

[52] Two empirical models are discussed later in Section 6.5.

empirical risk model and the empirical performance models separately in order to make the models more comprehensive.

6.2.1 Variables in the risk model

The dependent variable in the conceptual risk model is *Acquisition Risk.* As shown in the conceptual model, Model 5-1 (see Section 5.7 of Chapter 5), there are three main categories of independent variables: managerial wealth components, behavioural biases and monitoring mechanisms. The structure of the empirical risk model (see Section 6.5.1) remains the same as the conceptual risk model except that the empirical model contains some control variables that may also have some impact on managers' acquisition risk choices but that do not fall within the domain of the managerial wealth, behavioural biases and corporate monitoring literature. These variables are acquirer financial leverage, acquirer size and relative size of acquirer to target. The argument and definitions for these variables are discussed in this section.

6.2.1.1 Acquisition risk

As discussed in Section 5.3 of Chapter 5, high-tech acquisitions are risky investments. The inherent uncertainty associated with the rich intangible-assets embedded in high-tech targets presents the possibility that the attractive growth prospects of high-tech target may never be actually be realised by the acquirers. The combination of acquisition-related risks and intangibles-related risks create a unique risk profile for high-tech acquisitions, making them far riskier than low-tech acquisitions. High-tech acquisitions as a proxy for high-risk investment has been adopted by Kohers and Kohers (2001).

Some studies have found systematic differences in technology investments across industries, e.g., R&D spending is heavily concentrated in technology and science-oriented industries such as Biotechnology, Internet, Electronics (Francis and Schipper, 1999; Chan *et al*, 2001). These researchers however have not reached an agreement about what constitutes high-tech industries although it is commonly accepted that high-tech industries have higher intangible-asset levels than low-tech industries. Based on this criterion, Securities Data Company (SDC) provides a list of high-tech industries and this list has been used by some studies such as Kohers and Kohers (2001) and Fuller *et al* (2002) in their studies of high-tech acquisitions[53]. Table 6-1 lists the

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[53] Conn *et al* (2005) define UK industries as high–tech if the R&D expenditure to industry output is substantially above average. If the ratio is above, but not substantially above average, a second measure is employed based on the proportion of scientists, professional engineers and technicians in the labour force. They generate the following high-tech industry list: Chemicals, Plastics, Machinery and Equipment, Office Machines and Computers, Electrical Equipment, Electronics, Medical Instruments and Control Equipment, Telecommunication and Post, Software and R&D. As compared to the high-tech acquisition list in this thesis (see Table 6-1), the list by Conn *et al* contains more industries, including those industries which have both high-tech sectors and low-tech sectors. This can be illustrated by the example given by Harrison (2000). Harrison states that not all the sectors in Chemicals are high-tech. The commodity chemicals sector is a low-tech sector while the life science sector is a high-tech sector (more discussions can be found in Section 5.3 of Chapter 5). The high-tech industries defined in this thesis, e.g., biotechnology, computers, telecommunications, electronics, although not as broad as those by Conn *et al* (2005), are the typical high-tech sectors recognised by both researchers such as Francis and Schipper, 1999; Chan *et al*, 2001, Kohers and Kohers (2001), Fullers *et al* (2001), and the market as reflected in the stock prices of those industries during the internet/telecom bubble period of late 1990s. Moreover, the nature of those industries is consistent with the description of high-tech firms in Section 2.3 of Chapter 2.

Table 6-1: **High-tech industry sectors defined by SDC**

High-tech industry sectors	SDC high-tech industry code
Biotechnology	
1. In-Vivo diagnostic products	111
2. In-Vito diagnostic products	112
3. Genetically Eng. Prod (human)	113
4. Genetically Eng. Prod (animal)	114
5. Vaccines/Specialty Drugs	115
6. General pharmaceuticals	116
7. Over-the-counter drugs	117
8. Nuclear medicines	118
9. Medicinal chemicals	119
10. Drug delivery system (not IV system)	120
11. Blood derivatives	121
12. Research & development firm	122
13. Other biotechnology	129
14. Medical lasers	131
15. Medical imaging systems	132
16. Surgical instruments/equipment	133
17. Lab equipment	134
18. Rehabilitation equipment	135
19. Artificial organs/limbs	136
20. Medical monitoring systems	137
21. General Med. Instruments/Supp.	138
22. Healthcare services	140
Computer equipment	
1. Mainframes & Super Computers	211
2. Workstations	212
3. Micro-computers(PCs)	213
4. Portable computers	214
5. Turnkey systems	215
6. CAD/CAM/CAE/Graphic systems	216
7. Other computer systems	219
8. Printers	221
9. Disk drives	222
10. CD ROM drives	223
11. Networking systems (LAN, WAN)	224
12. Monitors/Terminals	225
13. Scanning devices	226
14. Modems	227
15. Other peripherals	229
16. Database software/programming	231
17. Operating systems	232

High-tech industry sectors	SDC high-tech industry code
18. Applications software (business)	233
19. Applications software (home)	234
20. Desktop publishing	235
21. Communication/network software	236
22. Utilities/file Mgmt. Software	237
23. Other software (incl. games)	239
24. Programming services	241
25. Computer consulting services	242
26. Data processing services	243
27. Other computer-related services	249
Electronics	
1. Semiconductors	311
2. Superconductors	312
3. Printed circuit boards	313
4. Process control systems	314
5. Precision/measuring test equipment	315
6. Search, detection, navigation	316
7. Other electronics	319
Communications	
1. Telecommunications equipment	401
2. Telephone interconnect equipment	411
3. Messaging systems	412
4. Cellular communications	413
5. Satellite communications	414
6. Microwave communication	415
7. Alarm systems	416
8. Facsimile equipment	417
9. Data Communication (exclude networking)	418
10. Other telecommunications equip	419
11. Internet services & software	420
Others	
1. Robotics	511
2. Lasers (excluding medical)	512
3. Nuclear (excluding medical)	513
4. Propulsion systems	514
5. Satellites (non-communications)	515
6. Advanced materials	516
7. Defence related	517
8. Advanced manufacturing systems	518
9. Other	519

high-tech industries defined by SDC. According Kohers and Kohers (2001) and Fuller *et al* (2002), if an acquisition target is in a high-tech industry classified by SDC, the acquisition is a high-tech acquisition. I adopt the same approach to define a high-tech acquisition. When an acquisition target is not in the high-tech industry classification defined by SDC, the acquisition is termed as a 'low-tech acquisition'. Table 6-2 provides an illustration of the low-tech industry sectors that appears in the sample[54] of this thesis. This definition of acquisition risk generates a 2-category dependent variable for the empirical risk model (see Section 6.5.1), high-tech acquisitions and low-tech acquisitions.

Table 6-2: An illustration of low-tech industry sectors in SDC

Sector name	Sector name
Agriculture	Auto Parts
Business Support Services	Building Materials
Builders Merchant	Clothing and Footwear
Education and Training	Environmental Control
Food and Drug Retail	Food Processors
Gambling	Hospital Management
Household Products	Media Equipment and Supplies
Mining	Paper
Publishing and Printing	Steel
Restaurant	Textile and Leather Goods
Transport	TV, Radio and Film

The shortcoming of this categorical classification of acquisition risk is that it misses out the technology differences across industries and firms. Although high-tech

[54] Section 6.4 describes the selection of the sample used in this thesis.

industries in general have a higher technology level than low-tech industries, there exist differences in technology levels among different high-tech industries. For example, biotechnology industry generally is considered have higher R&D capability than electronics (Francis and Schipper, 1999; Chan *et al*, 2001). Even within the biotechnology industry, different firms have different technology levels. An alternative approach to the two-category classification of acquisition risk is to use target industry or firm technology level data such as R&D intensity, patents, etc. This results in a continuous data type, which contains more information than a simple two-category classification. However, given that more than 90% of the sample targets are unlisted companies whose accounting information on intangible assets is not available from public sources[55], it is impossible to employ target firm level data. This also limits the use of other measures for target intangible assets such as book-to-market ratio, Tobin's Q ratio[56], goodwill, etc.

R&D Scoreboard provides industrial R&D intensity (R&D expenditure/sales ratio) for UK companies each year since 1990 (Tubbs, 2002). All its data is extracted directly from company annual reports and key ratios are calculated for each sector based

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[55] I also checked with FAME which contains private company data only to discover that FAME has incomplete data for intangible assets for most of the sample firms.

[56] Tobin's Q is calculated by dividing the market value of a company by the replacement value of its assets. According to Chung and Pruitt (1994), the market value of a company is the sum of market value of equity, the liquidating value of the company's outstanding preferred stock, and the value of the company's current liabilities minus current assets plus the book value of long-term debt. The replacement value of the assets is based on the book value of total assets of the company. A high Tobin's Q indicates that the company has rich growth opportunities considered by the market and a low Tobin's Q indicates a lack of growth opportunities.

on the Financial Times Stock Exchange (FTSE) actuary system. R&D Scoreboard includes both listed and non-listed companies[57]. This is also true of the sample used in this study. I therefore use industry level R&D intensity in the accounting year prior to acquisition announcement from R&D Scoreboard as the measure for the target industry R&D technology level. This approach also allows me to examine whether the high-tech industries as defined by SDC has significantly higher R&D capability than low-tech industries, a test of SDC's 'high-tech' definition.

Studies such as Fuller *et al* (2002) consider both acquire and target technology levels. Following Fuller *et al*'s approach would give rise to a four-way classification of acquisition risk:

1. high-tech acquirers versus high-tech targets;
2. low-tech acquirers versus high-tech targets;
3. high-tech acquirers versus low-tech targets;
4. low-tech acquirers versus low-tech targets

However, it is hard to judge whether a low-tech acquirer buying a high-tech target (category 2) is riskier than a high-tech acquirer buying a high-tech target (category 1). One can argue that a low-tech acquirer' relative lack of expertise in managing and valuing high technology growth businesses exposes it to a high risk of acquisition failure. On the other hand, combining two high-tech firms compounds risk and therefore is more risky than the former. Any demarcation of the acquisition risk in such acquisitions is very ambiguous. A similar ambiguity arises in differentiating between

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[57] Most of the publicly available databases such as Datastream, Company Analysis etc generally report data only for listed companies. Discussions of these databases are in Section 6.3.

category 3 and category 4. Therefore this study does not use a four-way classification of acquisition risk based on both acquirer and target technology level.

To summarise, this study uses two proxies for acquisition risk. The first is a categorical measure classifying acquisitions into high-tech acquisitions and low-tech acquisitions based on target high-tech industry status. The second is a continuous measure based on target industry R&D intensity in the accounting year prior to acquisition announcement.

6.2.1.2 Managerial wealth components

Managerial wealth components include cash compensation granted in the accounting year prior to an acquisition announcement, and all the holdings of LTIP cash or shares, stock options, and ordinary shares of the acquirer. Empirically, it is extremely difficult, if not impossible, to obtain all the cash compensation data for managers ever since they started working in a firm. This study therefore uses one year data to proxy for the general level of cash compensation. In contrast, it is possible to obtain data for the remainder of the components that are granted in years before the acquisition announcement and still not cashed in by their holders. This is because Greenbury Report (1995) and Hampel Report (1998) state that UK companies need to disclose directors' *holdings* of LTIPs, stock options and company shares in annual reports, not only the ones granted in the current year but also those accumulated over time. Managerial wealth data in this thesis is based on the annual report in the accounting year prior to acquisition announcement.

Company board of directors is used to proxy for top management. The board usually includes firm's top managers and non-executive directors. It determines a firm's strategic direction. Any big corporate decisions involve inputs from all of the board members and also need the approval of the board. It is also common for existing UK studies to use board of directors to proxy for top management[58]. Examples are Cosh and Hughes (1987), Sudarsanam *et al* (1996), Cosh and Hughes (1997), Dahya *et al* (2002), Weir *et al* (2002), Dahya and McConnell (2003), Sudarsanam and Mahate (2006), etc.

Fixed compensation and annual bonus

As defined in Section 2.3.2 of Chapter 2, fixed compensation is the sum of basic salary, fees, benefits-in-kind and pension contributions. Fixed compensation for acquirer directors is the total fixed pay of the whole board of directors in the accounting year before the acquisition announcement. Similarly, annual bonus for the acquirer directors is the total cash bonuses for the board of directors over the same time period. The total impact of both components is based on the sum of both values[59,60].

The reason why I consider the combined impact of fixed pay and annual bonus (FAB) is not only because they both discourage managerial risk taking (see Section

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[58] US-based studies such as Hall and Leibman (1998), Guay (1999) and Coles *et al* (2004) generally use CEO to proxy for top management. This however neglects the influence of other board members on corporate decision making and exaggerates the power of CEOs. Therefore this thesis uses board of directors as a proxy for top management.

[59] The sample period of this thesis is from 1993-2000. The inflation in the UK was very low during this period (the annual change in Consumer Price Index on average was just 2%). Therefore, this study does not adjust variables in £s assuming that the impact of inflation during this period is negligible.

[60] Empirical studies such as Williams and Rao (2000) adjust cash compensation by firm size or total compensation to allow for cross-sectional firm difference. This study uses both unadjusted cash pay (i.e., value term) and adjusted cash pay (by acquirers' total assets) in the regression analysis. This applies to all the wealth variables.

2.3.2 of Chapter 2), but also because of the limit on data availability. Prior to Greenbury Report (1995), annual reports generally do not disclose each individual component of directors' remuneration but only disclose the total emoluments including fixed compensation and annual bonus. Therefore, empirically it is impossible to test fixed pay and annual bonus separately for the majority of acquisitions conducted prior to 1996. Studies that examine the executive compensation prior to 1996 such as Cosh and Hughes (1975) and Main *et al* (1999) generally examine cash compensation as a whole. Although it is more likely to get separate data for fixed compensation and annual bonus from company's annual report since 1996, for consistency over time I use the combined measure throughout the analysis.

LTIP cash

LTIP cash (*LTIP CASH*) is measured by its cash value held by the acquirer board of directors up until the accounting year prior to acquisition announcement. After the Greenbury Report (1995) and Hampel Report (1998), annual reports in the UK generally disclose LTIP cash awards that remain outstanding, i.e., directors are yet to prove that they can meet the performance criteria set in the LTIP cash awards, in the year the annual reports are based upon. This includes the LTIP cash awards granted in the current year as well as those granted in past years but have not expired.

Equity delta

As discussed in Section 2.3.3 of Chapter 2, since Jensen and Murphy (1990), researchers use the sensitivity of a manager's wealth to a given change in stock price to measure the managerial risk incentive arising from managers' equity-based wealth components. This sensitivity is called 'equity delta'. Equity delta (DELTA) is in fact the slope of the relationship between a manager's equity-based wealth and stock price. A higher delta indicates a more sensitive relationship. Equity delta consists of the sum of the deltas from LTIP shares, options and managerial shareholdings. Section 2.3.3 of Chapter 2 introduces two ways to measure equity delta, the Jensen and Murphy (1990) approach (see Equation 2-1) and the Core and Guay (1999) approach (see Equation 2-2). The former is less popular than the latter because the former is argued to fail to appropriately reflect the equity incentive for a small increase of managers' shareholdings (see Section 2.3.3 of Chapter 2 for more details). This thesis therefore adopts the Core and Guay (1999) approach, a simplified version of which is given as Equation 2-2 in Chapter 2. The full equation for measuring equity delta (DELTA) is given below:

$$\begin{aligned} DELTA = {} & N_{LTIP\ share} * LTIP\ \ delta \\ & + \sum_{i}^{Q} \frac{M_i}{N_{option}} * M_i * Option\ \ delta_i \\ & + N_{share} * Share\ \ delta \end{aligned} \qquad \textbf{Equation 6-1}$$

where $N_{LTIP\ share}$, $N_{options}$ and N_{share} are the number of LTIP shares, options and managerial shareholdings respectively, which are based on the accounting year prior to an acquisition announcement. M_i is the number of options in tranche i. Q is the total number of tranches. Because directors usually hold many tranches of options[61], to

[61] The reason why directors hold many tranches of options is because stock options may be granted in different years with different expiry dates, or because stock options are granted via different executive compensation schemes such as Employee Sharesave Schemes, Executive Share Option Schemes, etc.

accurately estimate the total impact of options, empirical studies generally calculate the option delta for each tranche, (i.e., *Option delta*$_i$) separately and then take a weighted sum of all the tranches to get a total option incentive (Core and Guay, 1999). In the following subsections, I discuss the measurement of LTIP delta, Option delta, and Share delta for one LTIP share, one stock option and one managerial shareholding following Core and Guay (1999)'s approach.

LTIP delta

As shown in Section 2.3.3.1 in Chapter 2, empirical studies generally assume that an LTIP share changes by the same amount as the change in share price. Applying Core and Guay (1999)'s concept, LTIP delta for a one LTIP share is calculated as:

$$LTIP \quad delta = 1 * \frac{P}{100} \qquad \textbf{Equation 6-2}$$

where P is acquirer share price (Datastream code UP[62]) at the end of month –2 (where the acquisition announcement month is coded as month 0). There are two major reasons why I use this day. Firstly, allowing one to two months gap can avoid acquisition rumours that affect stock price movement prior to acquisition announcement. This is common practice in M&A literature. Secondly, using the stock prices based on the last day of month -2 prior to the event month helps with data collection from the

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Options granted via different schemes generally have different characters such as their exercise price and/or expiry date. This information is apparent from reading of the annual reports of the sample firms.

[62] This is the closing price that has not been historically adjusted for bonus and rights issues. This figure therefore represents actual or 'raw' prices as recorded on the day, which is what people use to estimate their stock value for a certain day.

Datastream[63] and the subsequent data sorting and calculations[64]. Rau and Vermaelon (1998) also use the month end of the month prior to the acquisition announcement month, 0[65]. For the same reason, all the stock market data is based on this time period. The LTIP delta for the whole LTIP share holding (LTIP DELTA) is the number of LTIP shares times LTIP delta as expressed in the first part of the right-hand side of Equation 6-1.

Option delta

Option delta is a partial derivative defined as the change in option value to a 1% change in the underlying stock price. Before introducing the equation for estimating option delta, I first present the valuation model for stock options. The Black and Scholes (1973) formula for European call options adjusted for continuously paid dividends (Merton, 1973) has become standard practice in executive compensation literature to estimate the value of executive options (Conyon and Murphy, 2000; Conyon and Sadler, 2001)[66]. The equation is as follows:

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[63] See Section 6.3 for a discussion about Datastream.

[64] In fact any day of the month can achieve the same effect as the last day of the month as far as the day is the same for all the sample companies.

[65] The existing M&A studies use different days. Some use the end of a month that is several months, usually one or two months, before an acquisition announcement month. Others use a fixed number of days, for instance 60 days, prior to an acquisition announcement day. There is no fixed rule but generally these studies allow for a few days before an acquisition announcement so that the stock price is least affected by the influence of acquisition rumours.

[66] However, using the Black-Scholes (1973) option pricing model to calculate the value of executive stock options is not without problems. See Section 7.4.1.1 for a discussion.

$$C = Pe^{-\ln(1+d)T} N(z) - Xe^{-\ln(1+r)T} N(z - \sigma\sqrt{T})$$

$$z = \frac{\ln(P/X) + [\ln(1+r) - \ln(1+d) + \sigma^2/2]T}{\sigma\sqrt{T}}$$

Equation 6-3

where,

C = option value

P = month end stock price (Datastream code UP) at month -2 prior to acquisition announcement month, 0

X = exercise price of the option

T = remaining time to maturity of the option, in years. It is measured by dividing number of days[67] from the end of month -2 prior to the acquisition announcement month, 0, to the expiry day of the stock option by 365.

d = the annualised dividend yield of the stock. It is calculated as the average of the prior 47[68] monthly annualised dividend yields (Datastream code DY) based on the percentage of gross dividend per share[69].

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[67] Some annual reports only disclose the expiry month and year of the options. In this case, last day of that month is assumed to be the expiry day. Since the unit of T is in years, this assumption does not have major impact on option value.

[68] Month -48 to month -2 prior to the acquisition announcement month, 0. I use month end value to be consistent with other stock related variables such as stock price P, and stock return volatility, σ.

[69] Conyon and Murphy (2000) argue that abnormal historical dividend yields are poor predictors of yields over the term of the option. Stated differently, firm's dividend yields, or in fact, firm performance are not always sustainable over time. Therefore they 'trim' dividend yields above 5% to 5%. This is also a way to mitigate the effect of outliers. This study follows their approach to reduce outliers.

σ = expected annualised stock return volatility over the life of the option. It is estimated as the standard deviation of monthly continuously compounded returns[70] over the prior 47 months[71], multiplied by $\sqrt{12}$ [72].

r = risk free annual discount rate. It is either the middle price (Datastream Code IR) of UK Treasury Bills[73] or the average redemption yield of UK gilts[74] depending on the remaining life of the stock option[75].

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[70] The monthly continuously compounded returns are calculated as Mr = $ln(1+R)$, where Mr is monthly continuously compounded return and R is the discrete monthly return.

[71] -48 month to -2 month prior to the acquisition announcement month, 0.

[72] Conyon and Murphy (2000) argue that abnormal historical volatilities are poor predictors of volatilities over the term of the option. Therefore, they trim the volatilities outside the range of 20% to 60%. This is also a way to mitigate the effect of outliers. This study follows their approach.

[73] There are two types of UK treasury bills, bills with one month to maturity (Datastream Code LDNTB1M) and bills with three months to maturity (Datastream Code LDNTB3M).

[74] Datastream provides government bond indices based on the European Federation of Financial Analysts revised calculation methods since 1985. There are 9 series of UK benchmark indices based on maturity band: 2 year maturity band (Datastream code BMUK02Y), 3 year maturity band (Datastream BMUK03Y), 5 year maturity band (Datastream code BMUK05Y), 7 year maturity band (Datastream code BMUK07Y), 10 year maturity band (Datastream code BMUK10Y), 15 year maturity band (Datastream code BMUK15Y), 20 year maturity band (Datastream code BMUK20Y) and 'All' (i.e. indefinite) maturity band (Datastream code BMUKALL). The redemption yield for bond i is calculated as $P = \sum_{i}^{N} \frac{CF_i}{[1+Y]^{t_i}}$ where P = Gross price, CF_i = ith cashflow, Y = redemption yield, N = the total number of cashflows. The weighted average redemption yield of a list of bond is calculated as follows: $\frac{\sum_s Y_s * V_s * AL_s}{\sum_s * V_s * AL_s}$ where Y_s is redemption yield of a bond, V_s is value of the bond (holding time price

$N(\,)$ = cumulative normal distribution

Delta for an option is then calculated as:

$$\begin{aligned} Option \quad Delta &= \frac{\partial C}{\partial P} * \frac{P}{100} \\ &= e^{-\ln(1+d)T} * N(z) * \frac{P}{100} \end{aligned}$$

Equation 6-4

The option delta for each tranche of options is the number of options in each tranche times the delta for an option in that tranche. The delta for the total option holding (OPTION DELTA) is the weighted sum of option delta for each tranche of options as expressed in the second part of Equation 6-1.

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divided by nominal value). AL_s is average life of the bond. The above information is taken from Datastream user manual.

[75]Unlike Conyon and Sadler (2001) who use 3-, 5-, or 7-year interest rate, this study adopts a more accurate match. If an option matures in no more than 2.5 months, the 1 month T-bill rate is used as the risk free rate. If it matures between 2.5 months and 1 year and 3.5 months (included), then the 3 month T-bill rate is used as the risk free rate. If it matures between 1 year and 3.5 months and 2.5 years (included), the average redemption yield of 2-year gilts is used as the risk free rate. If between 2.5 years and 4 years (included), the average redemption yield of 3-year gilts is used as the risk free rate. If between 4 years and 6 years (included), the average redemption yield of 5-year gilts is used as the risk free rate. If between 6 years and 8.5 years, the average redemption yield of 7-year gilts is used as the risk free rate. If between 8.5 years and 12.5 years, the average redemption yield of 10-year gilts is used as the risk free rate. The maximum time to maturity period in our sample is 12 years. The rate is based on the end of month -2 prior to acquisition announcement.

Current UK compensation disclosure requirements for directors are contained in the Greenbury (1995) report and are predicated on the expert opinion of the UK's Accounting Standard Board. UK companies are required to disclose, individually for all directors the full details of their option holdings including the number of shares under option, the exercise price of all the options, the dates from which the options may be exercised and the expiration dates, etc. However, the Greenbury (1995) also makes provision for less than complete share option information disclosure in certain circumstances and allows companies to opt for a more concise form of disclosure. In short, this requires companies to provide, again individually for all directors, (1) the total number of share options held, (2) the weighted average exercise price for the stock of unexercised options held, and (3) the maturity date of the longest dated unexercised options. A full disclosure will provide the data for all the inputs to the Black-Scholes model. Researchers have to make some assumptions if companies followed the concise disclosure. The data in this study show that only a minority of companies adopt the concise disclosure condition, an observation also made by Conyon and Sadler (2001). For those companies, this study assumes the portfolio average exercise price to be the exercise price of each tranche of options, and take the maturity date of the longest dated option to be the maturity date of each tranche of options.

Share delta

As discussed in Section 2.3.3.1 of Chapter 2, the value of managerial shareholdings changes in line with changes in share price. Applying the Core and Guay (1999) definition, share delta is calculated as:

$$Share \quad delta = 1 * \frac{P}{100}$$ **Equation 6-5**

where P is acquirer stock price at the end of month –2 prior to acquisition announcement month, 0.

The delta for managerial shareholdings (SHARE DELTA) is the total number of shares multiplied by Share delta as expressed in the third term of the right hand side of Equation 6-1.

Option vega

Following the approach used by Guay (1999), option vega is the partial derivative of Black-Scholes (1973)'s option value to 1% change in stock price volatility. It is formulated in Equation 6-6 below:

$$\begin{aligned} Vega &= \frac{\partial C}{\partial \sigma} * 0.01 \\ &= e^{-\ln(1+d)T} * N(z) * P * T^{(1/2)} * 0.01 \end{aligned}$$ **Equation 6-6**

As with option delta, vega for the total option holding (VEGA) is the weighted sum of vega for each tranche of options.

Concave impact of equity delta

Following Mishra *et al* (2000), the concave impact of equity delta is captured by a linear term and a squared term of equity delta[76]. The linear term reflects the impact of

[76] In addition to the measure for equity delta suggested above, Mishra *et al* (2000) use some cut off points to divide equity delta into different levels and examine the incentives provided by the delta at different

equity delta when it is at a low level and the squared term captures the impact of equity delta when it is at a high level. This approach has been commonly used in the existing literature to capture the concave impact of managerial equity ownership on firm performance or managerial risk taking (see Sudarsanam *et al*, 1996; Wright *et al*, 1996; Kohers and Kohers, 2001;Weir *et al*, 2002).

Interaction of equity delta and total wealth

The measurement of equity delta (DELTA) has been discussed in the last section. Total wealth (WEALTH) is the sum of the value of fixed pay and annual bonuses, LTIP cash, stock options, LTIP shares and managerial shareholdings. The measurement for the first three have been presented is the last section. The calculation of the value of LTIP shares and managerial shareholdings is discussed below.

The vesting of the LTIP shares depends on whether directors can meet the performance criteria embed in the LTIP shares or whether directors can remain in their companies until the end of the vesting period. To take account into the contingency nature of LTIP shares, Conyon and Murphy (2000), Conyon and Sadler (2001) and Stathopoulos *et al* (2005) estimate the value of LTIP shares by taking a discount of 20% of the ordinary share value as follows:

*LTIP share value = Number of LTIP shares * P * 80%* **Equation 6-7**

where the P is the underlying stock price at the end of month –2 prior to acquisition announcement month, 0. This study follows this approach but I am aware that the 20%

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levels. This thesis is not in favour of this approach because the cut off points are selected arbitrarily. The measure used in this thesis is more objective.

discount is highly arbitrary. Those authors do not provide a justification for why they use 20% instead of 10%, 30% or any other number. However, it is also difficult to reject the 20% and use any other percentage without sound theoretical or even statistically support which again is difficult to obtain due to the contingent nature of LTIP shares.

The value of managerial shareholdings is simply the number of managerial shareholdings times the share price at the end of month –2 prior to acquisition announcement month, 0.

6.2.1.3 Behavioural biases

As discussed in Section 3.3 of Chapter 3, a measure of behavioural biases requires data from which it is possible to infer each manager's psychology. This is by no means easy to capture let alone quantify for empirical purposes. Given the obvious difficulty of collecting such data, this study uses the three indirect measures used by the empirical studies presented in Chapter 3, i.e., firm past performance, stock market glamour rating, and media praise for the firm board of directors[77].

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[77] Hayward and Hambrick (1997) also use self-importance measured by CEOs' pay level as a proxy for hubris. I agree that CEOs with strong self-importance may be infected with hubris. However, I do not agree that CEO pay is an appropriate proxy for self-importance in this setting. As discussed in Section 2.4 of Chapter 2, a high pay can be associated with managerial risk-aversion. This weakens Hayward and Hambrick (1997)'s argument that a high level of CEO pay can enhance CEOs' self-importance leading to hubris. Therefore this study does not incorporate their measure of self-importance as a measure for CEO hubris. Malmendier (2004) uses the time when CEOs exercise their stock options as a proxy for CEO overconfidence. This study does not use this measure because UK annual reports generally do not disclose when directors exercise their options.

Past performance

Good past performance has argued to encourage overconfidence/hubris by Hayward and Hambrick (1997), Welsh (2001), Hletala *et al* (2003). These studies argue that successful past performance may make managers believe that they are capable of doing anything. This is how Jack Welsh felt about himself before the acquisition of Kidder, Peaboy in 1986 (see Section 5.5 of Chapter 5 for a discussion of GE's acquisition of Kidder, Peaboy). The acquisition failure of Kidder, Peaboy gave Jack a lesson of how people can be easily affected by hubris after a successful performance. Hayward and Hambrick (1997) state that successful past performance can make managers develop too much faith in the efficacy of their leadership skills and overestimate their own ability to manage an acquisition. Moreover, success reinforces managers' authority in the company and their decisions remain unchallenged. Such managers thus have an opportunity to exploit their superior managerial magic in more challenging businesses adventures.

Following Hayward and Hambrick (1997), past performance (PAST) is measured as the return of an acquirer's stock price at month –2 relative to the stock price at month –12 (month 0 is the acquisition announcement month). Stock return data is calculated from stock data from return index[78] (Datastream code, RI). 11 months stock return is calculated by applying the following formula:

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[78] Return Index, RI, on Datastream represents the theoretical aggregate growth in value of a share holding over a specified period, assuming that dividends are re-invested to purchase additional unites of an equity or unit trust at the closing price applicable on the ex-dividend date. From 1988 onwards, RI is constructed as follows:

$$R_{i,t} = \frac{RI_{i,t-1} - RI_{i,t-12}}{RI_{i,t-12}}$$ **Equation 6-8**

where $R_{i,t}$ is the monthly return for firm *i* in month *t*, *RI* is discussed in footnote 78.

Glamour status

Rau and Vermaelen (1998), Kohers and Kohers (2001), and Sudarsanam and Mahate (2003) suggest that a firm's glamour status contributes to managers' over-optimism. The glamour status can make bidder managers over-optimistic about the future investment prospects and it is likely that this over-optimism will lead to a risky acquisition strategy (see Section 3.3 of Chapter 3). Following these studies, this thesis uses the ratio of acquirer book value of equity to its market value as a negative proxy (BEME) for acquirer glamour status.

Market value of equity (Datastream code, MV) refers to the value at the end of month -2 prior to the acquisition announcement month, 0. Book value of equity (Datastream item, 305) is shareholders' funds less preference stock[79]. Given that accounting data is released several months after the accounting year end, empirical studies usually take several months accounting lag when matching the book value with the market value. For example, Fama and French (1992) take 6 months accounting lag.

$RI_{i,t} = RI_{i,t-1} \times \frac{P_{i,t} + D_{i,t}}{P_{i,t-1}}$ where P is the price on ex-date and D dividend payment associated with ex-date. Gross dividends are used and the calculation ignores tax and re-investment charges.

[79] In company analysis, the codes are {eq} for shareholders' equity and {eq.s.ps} for preference shares.

The sample data in this thesis shows that company accounts are usually released 3-5 months after the accounting year-end. Therefore in this study a minimum[80] of 5-month lag is used.

Media praise

Hayward and Hambrick (1997), Ranft and Neill (2001), Johnson and Orange (2003), and Malmendier and Tate (2005a) argue that top managers' ego may be massaged and inflated by a high and flattering media profile. The media tends to attribute firm performance to directors. They write approvingly of successful directors and often portray them as 'heroic' and larger than life. They set up awards to create 'superstars', such as 'Best Manager and Best Entrepreneur' by Business Week, 'CEOs of the Year' by Financial World, 'Best Performing CEOs' by Forbes, 'Person of the Year' by Time, etc (Malmendier and Tate, 2005a). 'Heroic' media portrayal may in

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[80] The lag varies across different acquiring companies depending on which month is acquisition announcement month and when is the accounting year-end. 5-month is the minimum period for the accounting lag. Specifically speaking, because the market value of equity is based on the month –2 prior to acquisition announcement month, 0, the accounting year-end should be no earlier than month -7. If the year-end is earlier than month -7, say month -6, the accounting lag then is 4 months. This breaches the rule of a minimum of 5-month accounting lag. In those cases, the second accounting year prior to acquisition announcement is used. I acknowledge that this way of matching accounting data with market data introduces some misalignment between these two types of data. This has also been pointed out by Fama and French (1992) and Strong and Xu (1997). However, this misalignment is inevitable for whichever the approach is used unless the researcher knows exactly when the accounting data is released to the market. This day should be used to calculate the accounting lag. This however, is extremely difficult for a large sample analysis like this thesis and probably is impossible if companies do not draw much media attention.

turn influence the directors' self-image, fostering the impression that those directors are in control, or they are 'miracle workers'. Due to the advertising effect of media, employees and also large audiences outside the firm tend to believe in the directors' managerial magic. This then reinforces the directors' inter- and intra-organizational power, enhancing their perceptions of self-importance and self-esteem. The speculative nature of high-tech acquisitions and the glamour associated with operating in high-tech businesses are likely to appeal to those managers, a typical example is Jean-Marie Messier of Vivendi Universal (see Section 5.5 of Chapter 5 for a story of Jean-Marie Messier).

This study uses media praise (MEDIA) as a measure of the media profile of acquirer directors in the run-up to the acquisitions based on the approach suggested by Hayward and Hambrick (1997). Directors' media profile is determined through content analysis of major, nationally distributed newspaper articles about the directors for the three years prior to an acquisition announcement. As argued by Hayward and Hambrick (1997), hubris is more likely to be activated by favourable press from nationally prestigious publications with high circulation than other publications. A favourable article in, say The Financial Times, is obviously read by more people and is more prestigious than an article in a locally distributed or trade newspaper.

Only articles specifically attributing a firm-related outcome to board of directors or otherwise commenting on directors' performance are considered in this study[81]. To obtain newspaper articles, I set the following search criteria in Factiva:

[81] See Section 6.3 below for a discussion of Factiva.

- sources of information: key newspapers with significant business coverage e.g. Financial Times, Sunday Times, the Times, the Guardian, the Independent, Wall street Journal Europe;
- article publication dates: from month -37 to month -2 to acquisition announcement month, 0;
- article subjects: analysis[82], commentary/opinion[83] , people profile[84], interview[85], survey/poll[86], management issues[87], output/production[88], performance[89], and profiles of companies[90];

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[82] According to Factiva, 'analysis' is an in-depth examination of the issues within a news item by the writer, including incorporation of comments from recognized experts. It does not include the personal opinion of columnists expressed in their regular columns or the editorial standpoint of a publication.

[83] According to Factiva, 'commentary/opinion' is writings which express the personal point of view of the writer. It includes regular columnists and guest columnists. It excludes editorials and letters to the editor.

[84] According to Factiva, 'people file' is biographical profiles of people in the news, including key management personnel.

[85] According to Factiva, 'interview' is an article based predominantly on an interview with a person or persons, or article presented in question and answer format.

[86] According to Factiva, 'survey/poll' is a story that reports, or is primarily based on the results of a survey, poll or questionnaire. It includes surveys of analysts and economists, public opinion polls, employee and employer surveys etc.

[87] According to Factiva, 'management issues' is management philosophy and techniques, executive compensation and bonuses, corporate governance

88 According to Factiva, 'output/production' is stories about the output of a company or industry, including production figures

89 According to Factiva, 'performance' is corporate and industrial performance

- article text contains the phrases: 'executive*[91] or director* or CEO or chairman or board and' company name.

I then read the articles generated by Factiva to filter out the ones that contained no commentary likely to induce hubris/overconfidence, such as:

- quotes from (direct or indirect) directors without any comment or opinion,
- share reactions to a new director without describing the directors' performance,
- forecasts,
- announcements of director nomination only.

Finally following Hayward and Hambrick (1997), I coded each remaining article by using the following scale:

- 3 points: the article is unequivocally favourable toward the directors;
- 2 points: the article is on balance favourable toward the directors but did contain some critical remarks;
- 1 point, the article is on balance neither positive nor negative about the directors;
- -1 point, the article is on balance negative about the directors but did contain some positive comments;
- -2 points, the article is unequivocally negative about the directors.
- 0 points is given to those acquirers who have no relevant articles.

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[90] According to Factiva, 'profiles of companies' is stories containing historical information about a company, including an in-depth description of its products and markets. It includes stories providing an overview of a company's management, competitors and financials.

[91] "*"means words starting with executive, such as executives.

Table 6-3 and Table 6-4 illustrate the criteria used to classify comments as either positive or negative. The articles that Table 6-3 is based on focus on company profile changes and how directors are associated with the company's profile change. For instance, a company's accounting performance has been substantially improved and this improvement is mainly attributed to the company directors' leadership. Table 6-4 focuses on articles commenting on director profiles, for example, interviews about director's success stories.

I acknowledge that this content analysis approach is quite subjective. While it is easy to tell those articles which are unequivocally favourable (coded 3), and which are unequivocally negative (coded –2), it is much more difficult to give the appropriate coding to those articles with both positive and negative comments. A degree of judgement is necessary. Hayward and Hambrick (1997) use 2 researchers to independently read and code each of the 138 articles used in their study. Any coding disagreement was discussed until the two researchers reached an agreement about their codings. This can to some extent reduce the subjectivity of the content analysis. However, given the large number of articles read in this thesis (14,053 articles were read in total, of which 1,287 were read in detail and assigned an appropriate code), help from other researchers was not forthcoming. Section 7.4.2 of Chapter 7 discusses how future research can reduce the subjectivity of this content analysis.

The weighted sum of scale points for all the articles about the board of directors for one acquisition is the measure of media praise (*MEDIA*) for the acquisition. The weighting is determined by the number of articles in each scale versus total articles identified relevant to a given acquisition. As shown in Table 7A-2 of Chapter 7, some acquirers have articles as many as 45 whilst some do not have any relevant articles.

Table 6-3: Association of company profile change with directors.

	Description of Company Profile Change	Association of directors with Company Profile Change
Positive	• Any combination of words that describe that accounting performance improved such as 'up', 'success', 'perfect', 'boost', etc. • Any statistics that show the value of the company increases. • Any words that describe the good impact that a corporate event such as listing and M&A, may have or have had on company, such as 'revitalise', 'remarkable recovery', 'improved', 'achievement', 'event of the period', etc.	• Directors photograph on the newspaper. • Any words that show the influence of the directors on the corporate performance or events, such as 'lead by', 'driven by', 'found by', 'under', etc.
Negative	• Any combination of words that describe bad firm performance such as 'fall', 'plunge', 'lose', 'down', 'backward', 'profit warning', 'weak', 'underperformance', 'disappoint its investors', 'never quite live up to expectations', 'struggle', 'far less well', 'crisis', etc. • Doubt from analyst or investors such as 'doubt', 'upset investor'.	• Any word describing directors leave the job, such as 'ousted', 'resignation' or 'departure after profit warning'.

Table 6-4 comments on directors' profile and performance

Positive	• Comments such as 'expertise', 'successful', 'be credited', 'bring a wealth of …', 'confident', 'talented', 'clear view', 'play a key role', 'legend', 'highly regarded', 'best', 'famous', 'heavyweight', 'super', 'top', 'greatest', 'transformed…into one of the most efficient…'. • Any word that shows the director is an expertise or pioneer in his area such as 'UK's first…' 'create', 'found', 'architect'. • Reporting that the directors have won some awards. • Interview to describe the directors' success story, how they founded the company, turned around the company, etc. • Comments on the director's contribution regarding a certain strategy, such as 'enhance competitiveness'.
Negative	• Negative words such as 'lose', 'arrogant', 'easy to get rid of people', 'a difficult person to work with', 'not appreciate his critics', etc. • Doubt from investors or analysts, such as 'unease among investors and analysts', 'yet to be convinced', 'whether… can maintain growth', 'scepticism', 'discontent', 'less confident', etc. • Words that associate directors with the company's failure, such as 'damage'.
Neutral	• Naming a new director with introduction of his/her past experience such as job title, but without commenting on their performance. • Interview to ask some general question about the directors such as 'what is your best moment in your management?', 'What is your favourite city?' • Interview about a director's comment on the development of the industry.

Weighting is adopted to reduce the skew of data distribution. Equation 6-9 explains how to calculate the points for an acquisition.

$$MEDIA = \sum_{i}^{N} \frac{M_i}{N} * M_i * P_i$$ **Equation 6-9**

Where

N = total number of articles quoted for an acquisition;

i = scale i;

P_i = points for scale i;

M_i = number of articles for scale i.

6.2.1.3 Monitoring mechanisms

This section discusses measures for the monitoring mechanisms such as external blockholdings, institutional blockholdings, board independence, non-duality and the presence of a remuneration committee.

External blockholdings and institutional blockholdings

According to the UK Companies Act 1985, shareholdings in excess of 5% of the relevant share capital[92] must be disclosed in the firm's annual report. Following this rule, UK empirical studies such as Sudarsanam *et al* (1996) generally use 5% as the criteria for distinguishing large shareholders from small shareholders. From 1990 when

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[92] According to section 198 (2) of the Part VI of Companies Act 1985, 'relevant share capital' means company's issued share capital of a class carrying rights to vote in all circumstances at general meetings of the company.

the Disclosure of Interests in Shares (Amendment) Regulations amended the percentage to 3%, researchers such as Weir *et al* (2002) redefine the criteria as 3%. In line with these studies, I measure external blockholdings (*LARSHR)* as the percentage of issued ordinary share capital in excess of 3%, beneficial and non-beneficial, held by shareholders other than board members and their close relatives[93] in the accounting year prior to the acquisition announcement year.

Following Brickley *et al* (1988) and Cosh *et al* (1989), institutional blockholders are comprised of unit trusts, investment trusts, pension funds, banks, and insurance companies[94]. Institutional blockholding (*INSTSHR*) is proxied by the percentage of issued ordinary share capital in excess of 3%, beneficial and non-beneficial, owned by held institutional investors in the accounting year prior to acquisition announcement.

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[93] Close relatives refer to directors' spouses and children. If both directors and their spouses hold shares in the company (may be because the company used to be their family business), the shares held by the directors' spouses are not included in the calculation of external blockholdings. Cases like this are not very common in the sample used in this thesis. I am aware that some annual reports may not disclose this type of shareholding, and I can only take those annual reports which disclose this type of shareholdings into account. This is to reduce the noise contained in external blockholdings as much as possible.

[94] Institutional shareholders are identified by 1) judging from their names, for instance NatWest, Barclays are banks in the UK; 2) checking on the FAME database (see Section 6.3 for a discussion of the database) to find the nature of their business; 3) checking on their companies' websites to see whether or not they are institutional shareholders. The above approaches can identify most institutional shareholders. Any companies that are unidentifiable particularly some foreign companies are excluded from the institutional shareholders' list. Although unidentifiable companies are very limited, I acknowledge that the level of institutional shareholding reported in this thesis is probably lower than it should be. Further research should use a more reliable database for institutional shareholders in the UK.

In some cases, there are duplications in the shareholdings of directors and external shareholders, for example, a director's shares held by an investment trust. In this situation, this holding is not considered part of external blockholdings, or institutional shareholdings because the investment trust may be influenced by directors.

Board composition

Consistent with the empirical literature discussed in Section 4.2.2 of Chapter 4, board independence (NEXE) is measured by the percentage of non-executive directors on the board prior to the acquisition announcement date[95].

CEO-COB Non-duality

Consistent with the empirical literature discussed in Section 4.2.3 of Chapter 4, a dummy variable is allocated to non-duality (NONDUAL) which equals 1 if the acquirer combines the posts of COB and CEO into one person prior to the acquisition announcement[96], and 0 otherwise.

Remuneration committee

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[95] If the data is from the PWC Corporate Register (see Section 6.3 below), board composition is based on the quarter prior to the announcement since PWC Corporate Register is issued every quarter. When the company can not be identified from the PWC Corporate Register, the annual report is used as the source of information. Board composition is then based on the date of Annual General Meeting prior to the announcement. See Section 6.3 below for a discussion of why two data sources are used for the same data.

[96] As with board composition, if the CEO-COB data is from the PWC Corporate Register, it is based on the quarter prior to the acquisition announcement; if from annual reports, it is based on the Annual General Meeting day prior to the acquisition announcement.

Consistent with the empirical literature discussed in Section 4.2.4 of Chapter 4, a dummy variable is allocated for the presence of a remuneration committee. The dummy equals 1 if the acquirer has a remuneration committee prior to the acquisition announcement[97], and 0 otherwise.

6.2.1.4 Control variables

Drawing upon the existing literature, I introduce three control variables into the empirical risk model (see Section 6.5.1 for a model discussion), financial leverage, acquirer size, relative size of acquirer and target[98].

Financial leverage

It is argued that debt provides an effective corporate control mechanism (Jensen, 1986; Weir *et al*, 2002; Nohel and Todd, 2005). Increased debt intensifies a firm's financial stress. This is threatening to managers because they may lose control of their firms or even lose their jobs. Therefore as a result, managers may use the excess funds in the firm more efficiently, or to service the debt in order to reduce the chance of bankruptcy. An alternative argument is that managers may accept high risk projects after taking on debts since some of the business risk will be borne by lenders - to the benefit of shareholders (Myers, 1977; Harris and Raviv, 1991; Leland, 1998). This is

[97] As with board composition and CEO-COB nonduality, if the remuneration committee data is from the PWC Corporate Register, it is based on the quarter prior to the announcement; if from annual reports, it is based on the Annual General Meeting Day prior to the announcement.

[98] I acknowledge that there may exist some other variables that may also have an impact on managerial risk taking.

supported by Rajgopal and Shevlin (2002)'s finding that highly leveraged firms take on greater exploration risk in oil & gas industry.

Both views suggest that debt level affects managers' project selection. Therefore, this study includes acquirer financial leverage (LEV) as a control variable. It is measured as the percentage of total liability over total assets in the accounting year prior to acquisition announcement.

Acquirer size

Moeller *et al* (2004) postulate that firm size affects the risk an acquiring firm is willing to bear. Large firms can take more risk by conducting bigger acquisitions, securing the acquisition by paying higher premium and quickly complete an offer. Using a sample of 12,023 US acquisitions from 1980 to 2001 from SDC database, Moeller *et al* find evidence supporting this argument. They investigate various reasons behind the size factor and speculate that managerial hubris is the driving factor since directors in big firms are more subject to hubris.

This study therefore includes acquirer size as one of the risk incentives. Acquirer size (MV) is measured by natural logarithm[99] of acquirer market value of equity at the end of month -2 prior to acquisition announcement month, 0[100].

Relative size of acquirer to target

[99] Take the natural logarithm of acquirer size can normalise the distribution of this dependent variable in the empirical risk regression model (Model 6-1).

[100] Section 6.2.1.2 has explained why market-related variables such as stock price, market value of equity are based on the end of month -2 prior to acquisition announcement month, 0.

Relative size of acquirer to target may also be one of the factors that influence managers' decision whether or not to take on risky acquisitions. When a target is small relative to its acquirer, the acquisition will have less of an impact on the acquirer's financial performance. When the target is big relative to the acquirer, if the acquisition fails, then it is likely to cause significantly more financial distress to the acquirer. The smallness of a target can also facilitate the integration of the target with the acquirer and help realize the expected synergies underpinning the takeover, therefore reducing the risk of the acquisition (Sudarsanam *et al*, 1996). Thus acquirer managers are more likely to buy targets which are small relative to the acquirer's size even if the chance of acquisition failure is high.

Therefore, the relative size of acquirer to target (RELSIZ) is included as a control variable. Relative size is measured as the natural logarithm[101] of the ratio of market capitalisation of an acquirer at the end of month –2 month prior to the acquisition announcement month, 0, over either the market capitalisation of the target firm at the same time or the transaction value of the acquisition if the target is a non-listed company.

6.2.2 Variables in the performance model

The dependent variable in the empirical performance model is acquirers' post-acquisition stock return performance. The independent variables include the level of

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[101] Take the natural logarithm of the relative size ratio can normalise the distribution of this dependent variable in the empirical risk regression model (Model 6-1).

'suboptimality' in acquisition risk and a control variable[102], payment method. Each of these variables is discussed in the following subsections.

6.2.2.1 Post-acquisition performance

M&A literature generally employs two approaches to measure post-acquisition performance: a stock-based approach and an accounting based approach. The latter is less popular because accounting data contains much more noise and is subject to earnings management (Healy *et al*, 1997). The former has become more widely accepted and is now the dominant approach in assessing listed-firms' performance, since the efficient market hypothesis of Fama (1970) states that share price should fully incorporate all available information regarding the security and thus provides accurate signals for corporate performance. Studies that employ a stock-based measure include Barber and Lyon (1997), Gregory (1997), Loughran and Vijh (1997), Rau and Vermaelen, 1998, Lyon *et al* (1999), Datta *et al* (2001), Sudarsanam and Mahate

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[102] Existing literature also suggests that the relative size of acquirer to target, mode of acquisitions (such as tender offers or mergers), and deal attitude (such as hostile or friendly takeovers) may have impact on post-acquisition performance (Sudarsanam *et al*, 1996; Mitchell and Stafford, 2000; Cosh and Guest, 2001). The impact of relative size of acquirer to target on acquisition decisions has been captured in the empirical risk model. Mode of acquisitions and deal attitude do not have much impact on this study. Tender offers in the UK are governed by the City Takeover code which almost exclusively applies only to bids for listed company targets (Sudarsanam, 1995, Chapter 6). Hostile takeovers are impossible with unlisted targets which are about more than 90% of the sample in this thesis (see Section 6.4). The data in this study shows only 1 tender offer and no hostile takeover. Therefore, these two variables are not included in this study.

(2003), Sudarsanam and Mahate (2006). This study uses a stock-based approach [103] and focuses on acquirer's 3-year buy-and-hold abnormal returns (BHARs) following acquisitions as a performance measure. The definition of BHARs and the method used to calculate them are discussed in Section 6.5.3.

6.2.2.2 Levels of optimal/suboptimal acquisition risk

The conceptual performance model (Model 5-2) discussed in Section 5.8 suggests the concepts of optimal-risk investment and two types of suboptimal acquisition risk, i.e. under-risk investment and over-risk investment. Empirically, two proxies are used for the level of suboptimality of acquisition risk. The first is a three-group classification of acquisition risk: under-risk (UNDINV), over-risk (OVEINV) and optimal-risk (OPTINV). The definition and method for generating these variables is described in Section 6.5.2. A dummy variable is allocated to indicate a UNDINV acquisition with a value of 1 for such an acquisition and 0 otherwise. The OVEINV group is similarly coded. The optimal-risk acquisition group is used as the reference group in the regression analysis to avoid perfect collinearity arsing from the dummy coding (Gujarati, 2003, Chapter 9),. The impact of either of the 'suboptimal-risk' acquisition groups is thus compared to the 'optimal-risk' acquisition group.

The second proxy for suboptimality of acquisition risk is a continuous variable. It is generated when the acquisition risk is proxied by target industry R&D intensity and

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[103] I acknowledge that stock-based measures for post-acquisition performance is not superior because they are influence by the stock market fluctuation. Some studies therefore prefer accounting-based measures such as Cosh and Guest (2001), Bild *et al* (2002). Measuring the post-acquisition performance is one of the difficult issues in the M&A literature.

is calculated as the difference between the actual target R&D intensity and the predicted target industry R&D intensity, i.e. optimal acquisition risk. It is coded as RESID. The definition and method for calculating (RESID) are discussed in Section 6.5.2.

6.2.2.3 Payment method as a control variable

Previous literature argues that payment method has a signalling effect (Myers and Majluf, 1984; Travlos, 1987; Sudarsanam *et al*, 1996; Loughran and Vijh, 1997; Rau and Vermaelen, 1998; Cosh and Guest, 2001; Cosh and Hughes, 2001; Shleifer and Vishny, 2003; Sudarsanam, 2003; Conn *et al*, 2005). If managers are better informed about the long-term aspects of their own firm than the market, they will tend to pay for acquisitions with stocks when they believe that their own firm's stocks are overvalued. A cash offer may indicate that managers have no such private information. Loughran and Vijh (1997) report that in the long run, bidding firm shareholders suffer a loss in wealth if the acquisition payment is made in equity, but a positive excess return if the acquisition involves a cash payment. For a sample of 1,970 acquisition from 1984-2000 covering the historically high market valuation period in the late 1990s, Akbulut (2005) finds that overvalued firms are more likely to conduct mergers involving stock payment. These firms are found to have high pre-merger but negative post-merger abnormal returns within 3 years after acquisitions.

Martin (1996) suggests that managers tend to offer equity when they are buying targets with high growth opportunities, since such acquisitions typically involve considerable information asymmetries, paying with equity helps reduce the valuation risk. In high-tech acquisitions with large scope for valuation errors, equity financing is more likely to minimise the valuation risk to acquirers than is payment with 100% cash.

Therefore this study includes payment method as a control variable. NONCASH is a dummy variable coded 1 for noncash payment , and coded 0 for 100% cash payment[104].

6.2.3 Summary

This section discusses the variable definitions in the risk model and performance model. A summary of these variables is listed in Table 6-3.

[104] Some studies such as Sudarsanam and Mahate (2003) use three-way classification, i.e., 100% stock offers, 100% cash offers and mixed offers. The data in this thesis shows that equity is a major component of mixed offers. Therefore I use a two-way classification of payment method, i.e., noncash and cash instead of using a three-way classification. Studies use a two-way classification include Kohers and Kohers (2001), Conn *et al* (2005), etc.

Table 6-5: Variable definitions

Variable	Description	Proxy for:
	Empirical risk model (Model 6-1) [105]**:**	
Dependent variables:		
Target high-tech industry status	Dichotomous variable equal to 1 for acquisitions of targets in high-tech industries and 0 for acquisitions of targets in low-tech industries	Acquisition risk
Target industry R&D intensity	Target industry R&D intensity level (R&D expenditure/sales)	Acquisition risk
Independent variables:		
FAB	The sum of fixed compensation and annual bonuses for acquirer board of directors	Managerial risk incentive from fixed and short-term compensation
LTIPCASH	LTIP cash awards held by acquirer board of directors	Managerial risk incentive from LTIP cash compensation
DELTA	The sum of the delta values of LTIP shares (LTIP DELTA), options (OPTION DELTA) and ordinary shares (SHARE DELTA) held by acquirer board of directors.	Managerial risk incentive from the change in company value
$DELTA^2$	The squared term of DELTA	Nonlinear managerial risk incentive from change in company value
DELTA * WEALTH	Interaction of DELTA and managerial total wealth	Joint impact of managers' wealth and their risk incentive
VEGA	Vega value of options held by acquirer board of directors	Managerial risk incentive from change in company stock volatility
VEGA * WEALTH	Interaction of VEGA and managerial total wealth	Joint impact of managers' wealth and their option-based risk incentive
PAST	The return of an acquirer's stock price at month –2 relative to the stock price at month –12 (month 0 is the acquisition announcement month	Managerial behavioural biases
BEME	Acquirer book value of equity to market value of equity	Managerial behavioural biases (negative proxy)

[105] Model 6-1 is under Section 6.5.1

Table 6-5 (continued)

Variable	Description	Proxy for:
MEDIA	Media praise in UK key newspapers for acquirer board of directors from month -37 to month -2 prior to acquisition announcement month, 0	Managerial behavioural biases
LARSHR	% of ordinary shareholdings (beneficial and non-beneficial), greater than 3%, held by non-board members and institutions	Shareholder monitoring and control of managers
NEXE	% of non-executive directors on the acquirer board	Board monitoring and control of executive directors
NONDUAL	Separation of acquirer CEO and chairman roles	Board monitoring and control of managers
REM	Existence of remuneration committee of an acquirer's board	Board monitoring and control of managers' remuneration
LEV	% of acquirer total liability to total asset	Lender monitoring
MV	Acquirer market value of equity at the end of month –2 prior to acquisition announcement month, 0	Size effect
RELSIZ	Acquirer size relative to target size	Capacity for risk taking
	Empirical Performance Model (Model 6-4)[106]:	
UNDINV	Actual acquisition risk level lower than predicted risk level	'Under-risk' acquisition
OVEINV	Actual acquisition risk level higher than predicted risk level	'Over-risk' acquisitions
RESID	Residuals of the risk model when the dependent variable is target industry R&D intensity	'Suboptimal' acquisition risk
NONCASH	Acquisition currency not in 100% cash	Signalling; reduction in valuation risk

[106] Model 6-4 is presented under Section 6.5.4.2.

6.3 Data sources

The M&A data used in this study are taken from the Securities Data Company Merger &Acquisition database ('SDC' hereafter). SDC provides detailed quantitative information about M&As worldwide. It is the most comprehensive source of mergers and acquisitions worldwide (Ang and Kohers, 2001) and the major source of data for acquisition-related empirical studies such as Rau and Vermaelen (1998), Datta *et al* (2001), Kohers and Kohers (2001), Sudarsanam (2003), Conn *et al* (2005)[107]. However, SDC doesn't provide information about firm name changes following acquisitions. To match SDC database information with the information from other databases, Financial Analysis Made Easy (FAME) and Perfect Analysis are used to track for firm name change history. The FAME database provides company information such as accounting data, stock price data, company fundamentals and activities, etc. on 1.65 million UK and Irish public and private companies. Perfect Analysis provides similar information as FAME but on a global base and for listed companies only.

The stock data and accounting data are taken from Datastream database ('Datastream' hereafter). Datastream contains a vast number of economic, company,

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[107] Another source of UK M&A data is Acquisitions Monthly. It is a monthly magazine summarising the major acquisitions happened during the month. Both Acquisitions Monthly and SDC belong to the same company, Thomson Financial. Conn *et al* (2005) collect M&A data from both data sources and find a large number of overlap between these two databases, but SDC reports over 50% more acquisitions than Acquisitions Monthly and covers most of the acquisitions reported by Acquisition Monthly. However SDC still neglects some acquisitions which are picked up by Acquisitions Monthly. While relying on SDC as the only data source, this thesis acknowledges this data source bias, although the influence might be small.

and financial data for global companies. It is the major source of data for stock-market-related and accounting-related UK company research. When accounting data is missing in Datastream, the Company Analysis database ('Company Analysis' hereafter) is used. Company Analysis specialises in providing accounting data for UK and other international companies. Managerial wealth data is taken from company annual reports provided by Thomson Research, one of the biggest financial database providers in the world.

Board structure and remuneration committee data is extracted from the PWC Corporate Register (published by Hemmington Scott). This database discloses board-related information once a quarter. Therefore it provides more up to date data than is provided by annual reports. However, the PWC Corporate Register has incomplete board sub-committee data, especially prior to 1996. Hence, Thomson Research is used as the reference database. Media praise for directors is from newspaper articles provided by Factiva. Factiva provides business news and information. It uses more than 9,000 sources including the Wall Street Journal, and the Financial Times, etc.

Executive compensation and equity-ownership data is extracted from Remuneration Committee Reports or Directors' Reports in firms' annual reports. These reports typically contain a breakdown of the remuneration packages provided to employees of the company in general, and detailed information on the compensation of individual executive directors. In particular, they disclose salaries and bonuses paid to individual directors, and give details of any stock options and LTIPs granted to the directors. In the past, one difficulty in using the Black-Scholes' approach (see Section 6.2.1.2) has been the unavailability of data on crucial parameters in the formula. Conyon and Sadler (2001) examine the likely biases introduced by the need to approximate or assume values for some key variables due to incomplete information disclosure by companies in the US. Contrasting US disclosures with that in the UK, they argue that due to the publication and implementation of the Greenbury (1995) and Hampel (1998) reports, the level of disclosure of compensation information in UK annual reports is now such that there exists sufficient information in the UK company annual reports to analyze the design of British CEO compensation contracts. Consistent with their assessment, I find that the data in UK annual reports indeed allows observation or inference of information regarding the Black-Scholes parameters from annual reports – not only for CEOs but also for all directors.

Data relating to target industrial R&D intensity is taken from R&D Scoreboard. R&D scoreboard has become the recognized international tool for benchmarking R&D investment (Cookson, 2002). It is prepared for the Department of Trade and Industry by Company Reporting in Edinburgh and is published online[108]. All its data is extracted directly from company annual reports and key ratios are calculated for each company and sector.

6.4 Sample selection

Using SDC, I identify all the UK domestic M&As during the period 1993-2000. This sample period follows the publication of the Cadbury Report in 1992 which recommends that companies adopt a rigorous corporate governance regime. The sample period also covers the internet/telecom bubble period of the late 1990s during which many acquisitions were accompanied by stunningly elevated market valuations for high technology firms all around the world, as well as the excessive grant of stock option

[108] The website is www.innovation.gov.uk

grants in the corporate world. Included in this study's sample are acquisitions that meet the following criteria:

1) acquisitions are announced and completed within the sample period;
2) acquirers are listed companies with stock price data available in Datastream;
3) neither acquirers nor targets are in the regulated 'financial industry' or 'utility industry'[109];
4) acquirers bought more than a 50% stake in their target firms[110].

There are 459 acquisitions whose targets are in the high-tech industries defined by SDC (Table 6-6), and there are 3243 low-tech acquisitions. The 459 high-tech acquisitions form the initial high-tech sample. This study then excludes those acquisitions in which acquirers do not have positive book value of equity[111], acquisitions in which acquirers have stock return data which does not extend to more than one year prior to acquisition announcement[112], and acquisitions in which acquirers

[109] Companies in these industries are excluded since they face different regulatory environments from those of companies in other industries.

[110] Although effective control may be achieved through a holding of less than 50% of a firm's issuing shares, the constraint set will ensure that bids examined are only those where it is unambiguously clear that control of the target has passed to the acquirer.

[111] See Section 6.5.3.3. below for the reason why firms with a negative book-to-market ratio are excluded from analysis.

[112] To obtain the data for past performance (PAST) and the data for acquirer momentum (one of the criteria for finding a control firm to calculate BHARs, see Section 6.5.3.3), acquirers' one-year stock return data prior to acquisition announcement is required.

do not have annual reports available, or those for which SDC reports no transaction value[113]. This leaves the final high-tech sample at 289[114].

The next step is matching each high-tech acquisition with a low-tech acquisition according to the following five criteria.

1) Target firms have the same public status. A growing body of literature, e.g. Chang (1998), Ang and Kohers (2001) Fuller *et al* (2002) and Cosh *et al* (2005) report that buying private companies is different from buying public companies. One of the differences is that there is being more cooperation between bidding and target firms in acquisitions of privately held companies than in acquisitions of publicly held companies. Buying a publicly held company can be conducted via hostile takeover if managers of the target company are not willing to sell. The Acquirer thus will have to pay a large acquisition premium and may have negative post-acquisition performance. In contrast, an acquirer of a private firm not buy the firm without the consent of the target firm's shareholders who, in many cases, may also be the managers. There may be even better cooperation if the target shareholders are

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[113] All these constraints are to ensure that there are valid data for each observation included in the regression analysis and to achieve consistency cross different analyses in terms of sample size. I acknowledge that this creates the sample selection bias.

[114] Some studies e.g. Gregory (1997) impose size constraint upon acquisitions, i.e., any acquisitions with a transaction size less than the constraint is not included. These studies argue that when the acquisition is small, it will not have a significant impact on acquirer stock returns. The threshold however, is an empirical issue and varies across studies. It can be £10million, £50million, or others. I do not impose any size threshold because of the sample size concern. A £10 million restriction would result in only 91 high-tech acquisitions while a £50 million cut off point would reduce the size of high-tech acquisitions to 30 observations.

willing to accept the acquirer' shares as a payment for the acquisition. This means that target shareholders believe in the prospect of the joint firm and may exert efforts in helping the acquirer to improve the joint firm's performance. The cooperation between acquirers and targets can substantially reduce information asymmetry between the two companies and consequently decrease acquisition risk, which helps create value for the joint firm[115]. Therefore, acquisitions of private targets have different risk profile and post-acquisition performance than acquisitions of public targets. Given that the high-tech acquisitions in the sample are dominated by private and public (but unlisted) target companies, it is necessary to use target public status as one of the criteria to find matching low-tech acquisitions.

2) Acquiring firms are in the same industry as defined by Datastream INDC4 (see Section 6.5.3.3 below for a discussion of Datastream industry classification). The logic behind finding matching low-tech acquisitions is to investigate what drives acquirers of similar characteristics to go for high-risk acquisitions rather than low-risk acquisitions. Industry affiliation is an important firm characteristics and has long been incorporated in constituting benchmarks for different purposes, such as calculating acquirers post-acquisition abnormal returns (Barber and Lyon, 1996; Kohers and Kohers, 2001). Therefore, acquiring firm industry affiliation is used as one of the matching criteria. As will be discussed in Section 6.5.3.3, the industry classification Datastream INDC4 is not so specific that it can make other matching criteria or filters invalid. It is also not so general that it will looses its filtering effect. Therefore, the industry filter is based on Datastream INDC4.

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115 More discussions about the differences between buying a publicly held firm and buying a privately held firm can be found in Conn *et al* (2005)

3) Acquiring firms are roughly of similar size. Firm size has long been argued as one of the key factors that determine firm risk profiles (Banz 1981; Fama and French, 1992; Fama and French, 1995; Ikenberry *et al*, 1995; Strong and Xu, 1997). As discussed earlier in Section 6.2.1.4, firm size affects the risk an acquiring firm is willing to bear. Therefore, size is included as a matching criterion.

A size filter of 70% to 130%[116] is introduced. Specifically, if the closest size of an acquirer in the low-tech acquisition group is not within the size filter of 70%-130% of the acquirer of the sample high-tech acquisition, then the industry filter is based on a more general industry classification, Datastream INDC3. If a matching low-tech acquisition is still not found, then the industry filer is relaxed to allow all industries except the financial and utility industry. If still no suitable matching low-tech acquisition is identified, the 70%-130% size filter can be relaxed to the closet match in acquirer size. Size is measured by the market capitalisation of the acquirer at the end of month -2 prior to acquisition announcement month, 0.

4) The same low-tech acquisition can only be used once as a matching acquisition, i.e., there are no duplicate low-tech acquisitions in the low-tech acquisition group. This is to ensure that both the high-tech acquisition group and the low-tech acquisition group have similar sizes so that they are comparable to each other.

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[116] The 70%-130% size filter is based on Barber and Lyon (1997). They acknowledge that the scope of the size filter, i.e. 70% and 130%, is set without theoretical adjustment but is only an empirical issue. I also acknowledge this limitation of using the size filter with no strong theoretical justification. An alternative scope of size filter, however, is equally theoretically unjustifiable. Therefore I still use 70% - 130% the size filter following the study by Barber and Lyon (1997).

5) Acquirers of the low-tech targets do not conduct high-tech acquisitions 3 years prior to or after the matching high-tech acquisitions. This study exams 3-year post-acquisition performance which assumes a market efficiency of 3 years(see Section 6.5.3 for details). If an acquirer conducts two acquisitions, one high-tech acquisition and the other low-tech acquisition within 3 years, the calculated acquirer performance following the acquisition that is conducted earlier will be contaminated by the later acquisition. This does not help identify the factors that distinguish these two different types of acquisitions from each other.
6) All the criteria set for high-tech acquisitions are imposed upon the selection of low-tech acquisitions.

This generates a low-tech acquisition group consisting of 289 low-tech acquisitions. Among these acquisitions, 93 acquisitions are matched on INDC4, 119 are matched on INDC3 and 60 are matched on all industry (excluding the financial and utility industries). The size filter is relaxed for 17 of the acquirers to the closest acquirer size match.

Table 6-6 shows the distribution of M&As for the high-tech acquisition group and the matching low-tech acquisition group for the period 1993-2000. Both acquisition groups are composed of 289 observations. High-tech acquisitions mostly cluster between 1997 and 2000. Only 11 acquisitions take place in 1993, but 91 occur in 2000. In contrast, low-tech acquisitions are relatively evenly distributed[117].

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[117] It could be because low-tech acquisitions are not matched by the announcement or completion year of the high-tech acquisitions. The reason why year filter is not imposed is because there are already five matching criteria on identifying a matching low-tech acquisition. As discussed in the main text, industry and size filters have lost their constraints on some of the acquisitions, e.g. 60 out of 289 high-tech

Table 6-6 Sample distribution by calendar year, 1993-2000

Year	High-tech acquisitions		Low-tech acquisitions	
	N	% of high-tech acquisitions	N	% of low-tech acquisitions
1993	11	3.81	21	7.27
1994	26	9.00	43	14.88
1995	18	6.23	29	10.03
1996	24	8.30	31	10.73
1997	45	15.57	37	12.80
1998	34	11.76	54	18.69
1999	40	13.84	36	12.46
2000	91	31.49	38	13.15
Total	289	100	289	100

The whole sample is then split into two subsamples: acquisitions over 1993-1997 and acquisitions over 1998-2000. The two subsamples are then examined separately. Starting from the 1997 accounting year, following Hampel Report (1998) UK companies disclose the full details of the individual director's option holdings including the number of shares under options, the exercise price of all the options, the dates from which the options may be exercised and the expiration dates, etc. The 1998-2000 sample thus has more complete director wealth data than 1993-1997 sample and therefore facilitates a more detailed analysis of the impact of managerial wealth on managerial risk taking. In the 1993-1997 sample, there are 124 high-tech acquisitions and 161 low-tech acquisitions. In the 1998-2000 sample, which captures the peak of the telecom and Internet bubble, there are 165 high-tech acquisitions and 128 low-tech acquisitions.

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acquisitions do not have the industry filter and another 17 acquisitions do not have size filter. Adding one more filter, year filter, will make other filters have little effect.

6.5 Methodology

This section discusses the methodology that is used in the subsequent analyses. The analyses consist of five steps.

1. The construction of an empirical risk model.
2. Identification of optimal-risk, over-risk and under-risk acquisitions.
3. Estimation of 3-year post-acquisition wealth gains to acquirer shareholders.
4. Estimation of the impact of optimal and suboptimal acquisition risk on shareholder wealth gains.
5. Additional tests on the relationship between acquirer shareholder wealth gains and various risk incentives.

Steps one to four involve examining the two conceptual models: Model 5-1 and Model 5-2. The purpose of step five is to provide a comparison against the one-stage analysis of the relationship between firm performance and factors that influence managers' investment behaviour. Each step involves different statistical analysis methods which are explained in the following sections.

6.5.1 Empirical risk model

Stage one involves a regression analysis using empirical proxies for wealth risk incentives, behavioural biases, monitoring mechanisms and control variables as set out in Model 6-1 below.

$$
\begin{aligned}
Acquisition\ \ Risk_i = {} & \alpha_0 + \alpha_1 FAB_i + \alpha_2 LTIPCASH_i + \alpha_3 DELTA_i + \alpha_4 DELTA_i^2 \\
& + \alpha_5 VEGA_i + \alpha_6 DELTA_i * WEALTH_i \\
& + \alpha_7 VEGA_i * WEALTH_i \\
& + \alpha_8 PAST_i + \alpha_9 BEME_i + \alpha_{10} MEDIA_i \\
& + \alpha_{11} LARSHR_i + \alpha_{12} NEXE_i + \alpha_{13} NONDUAL_i + \alpha_{14} REM_i \\
& + \alpha_{15} LEV_i + \alpha_{16} MV_i + \alpha_{17} RELSIZ_i + \mu_i
\end{aligned}
\qquad \textbf{Model 6-1}
$$

where i is the ith acquisition. The variable definitions are listed in Section 6.2.1. a is the coefficient of each variables. μ is the statistical error term.

Model 6-1 is the empirical risk model. It is estimated based on two types of regression models – logistic regression and OLS regression. A logistic regression relies on a broad categorisation of acquisition risk into just two levels (i.e., target high-tech or target low-tech) whereas an OLS model relies on a wider and continuous measure of acquisition risk (i.e., target industry R&D intensity across both high-tech and low-tech acquisitions). The latter measure involves less loss of information that may be potentially of value in determining 'over-risk' or 'under-risk' acquisitions. The following two subsections discuss these two types of regressions separately. Logistic regressions are a special form of OLS regressions. Therefore OLS regressions are discussed first in the next section.

6.5.1.2 OLS regression

Ordinary Least Square (OLS) regressions are used to predict the variance of the dependent variable from linear combinations of interval, dichotomous, or dummy independent variables by applying an ordinary least squares approach (Gujarati, 2003, Chapter 3). The dependent variable in an OLS regression is of a continuous data type. An OLS regression can establish the significance level of a set of independent variables explaining a proportion of the variance in a dependent variable (significance test of R^2), and can establish the relative predictive importance of the independent variables (comparing coefficient weights). The Student's t-test is used to assess the significance of individual coefficients. R^2 explains the percent of the variance in the dependent variable explained uniquely or jointly by the independent variables. F tests are used to test the significance of R^2, i.e., model significance. However, R^2 increases with the number of independent variables thus may give a false impression of the explanatory power of the model. To mitigate this effect, adjusted R^2 is introduced, which is the R^2 adjusted for the number of degrees of freedom. Therefore, adjusted R^2 instead of R^2 will be reported in the regression model output.

To properly perform OLS regressions, researchers need to follow certain rules. A violation of these rules may introduce severe biases into the model. Common violations in cross-section regressions include the outlier problem, multicollinearity and heteroscedasticity. The econometrics literature has developed some remedial methods to correct these data problems (Gujarati, 2003, Part II).

An outlier is an observation that is very different from other observations in the sample. The inclusion or exclusion of such an observation, especially if the sample size is small, can substantially alter the results of the regression analysis. Common approaches to eliminate outlier problems are deleting them, or winsorizing them. The winsorizing process involves setting the tail values equal to a certain lower percentile value, thus reducing the impact of some extreme outliers (Cowan and Sergeant, 2001). As compared to deleting outliers, the winsorizing approach can avoid reducing the sample size, and therefore is more popular with researchers. Following Sudarsanam and Mahate (2003), this study sets all values beyond 2 standard deviations away from the mean to 2 standard deviation away from mean.

Multicollinearity, where several predictors are highly correlated, also causes a violation. The use of a variance inflation factor (VIF) is a common way of detecting multicollinearity. As a rule of thumb, if the VIF of a variable exceeds 10, then that variable may seriously correlated to another variable in the model (Gujarati, 2003, Chapter 10).

Another typical violation is heteroscedasticity, which occurs when the error terms change depending upon the value of one or more of the independent variables. White (1980) develops a test for detecting heteroscedasticity and recommends the White (1980) heteroscedasticity-adjusted t-statistics in place of student's t-statistics in OLS regressions.

6.5.1.3 Logistic regression

While linear regression is robust in many cases, several instances exist in which the failure of some linear regression assumption leads to unreliable estimates. Such a case may exist when the dependent variable is categorical. A range of techniques have been developed for analysing data with categorical dependent variables, such as discriminant analysis, and logistic regression. Discriminant analysis has strict assumptions with regard to the characteristics and distributions of independent variables, for instance, they need to be jointly normal with equal covariance matrices. Logistic regression is not restricted by such assumptions and can incorporate independent variables of any type. It applies a maximum likelihood estimation after transforming the dependent into a logit variable (the natural log of the odds of the dependent variable occurring or not). In this way, logistic regression estimates the probability of a certain event occurring (Gujarati, 2003, Chapter 5).

Logistic regression has many analogies to OLS regression: it has logit coefficients for every independent variables, a pseudo R^2 statistic (i.e., a measure similar to a R^2 in OLS regression) is available to summarize the strength of the relationship. Outliers and multicollinearity can lead to biased estimation. Therefore in the logistic regression performed, I apply a winsorizing approach to replace the outliers with the values equal to 2 standard deviations from the mean. A VIF test is also conducted to diagnose any multicollinearity. Unlike OLS regression, however, logistic regression does not assume linearity of the relationship between the independent and dependent variables, and in general has less stringent requirements on normality or homoscedasticity of the variables. The success of the logistic regression can be assessed by looking at the classification table which shows correct and incorrect classifications of the dependent variable. Also, in logistic regression, goodness-of-fit tests such as model chi-square are available as indicators of model appropriateness, as is the Wald statistic to test the significance of individual independent variables.

However, unlike OLS regression whose coefficient reflects how much an independent variable has an impact on the dependent variable, the logit coefficient of a logistic regression can only deliver the message whether the change of an independent variable is in favour of or against the event of interest happening. The logit coefficient L is expressed as:

$$L_i = \ln(\frac{P_i}{1 - P_i})$$ **Equation 6-10**

where

P_i = the probability of an event i happening;

$\frac{P_i}{1 - P_i}$ = the odds ratio of an event i happening, i.e., the ratio of the probability that the event i happening to the probability that it will not happen.

L_i is therefore the log of the odds ratio. If it is positive, it means that when the value of the independent variable increases, the odds that the dependent variable is equal to 1 (meaning that event i happens) increases. If L_i is negative, it means the odds that the dependent variable being equal to 1 decreases as the value of the independent variable increases. L_i can be transformed into an odds ratio by taking an exponential form. An Odds ratio reflects the magnitude of the odds of an event i happening with respect to a unit change in the independent variable.

6.5.2 Identification of optimal/suboptimal-risk acquisitions

Step two involves the identification of optimal/suboptimal acquisition risk levels based on the prediction of the empirical risk model (Model 6-1). When the risk model is estimated using logistic regression, the unbiased Lachenbruch holdout procedure (Lachenbruch and Mickey, 1968) is used to estimate the probability of a sample acquisition belonging to the high risk or low risk group. The logistic model's classificatory accuracy may be positively biased when the test sample used to estimate the model and the prediction sample are the same. One way to minimise this bias and enhance classificatory accuracy is to estimate the model with the test sample and then use the model classify a different, hold-out sample. This increases the sampling requirement. An alternative and efficient procedure is the Lachenbruch hold-out procedure that estimates the logistic model using the test sample minus one observation which is then classified. This procedure is iterated by holding out one observation at a time, re-estimating the model and then using the model for classification. The classificatory rate is now free of upward bias. The procedure estimates the probability of the held-out observation belonging to one of the groups and then classifies it to the group with the highest probability. This is the predicted group for that observation. All the acquisitions thus have a predicted risk group using this Lachenbruch hold-out procedure.

The following test in Model 6-2, is applied to determine different categories of acquisition risk:

$$\begin{aligned} \textit{Type of acquisition risk} &= UNDINV,\ \textit{if}\ Risk_i < \overline{Risk_i} \\ &\quad OPTINV,\ \textit{if}\ Risk_i = \overline{Risk_i} \\ &\quad OVEINV,\ \textit{if}\ Risk_i > \overline{Risk_i} \end{aligned} \qquad \textbf{Model 6-2}$$

An acquisition is considered an *UNDINV* when its actual risk group ($Risk_i$) is lower than the predicted group, $\overline{Risk_i}$. An acquisition is considered an *OPTINV* when its actual risk group is equal to the predicted risk group. An acquisition is considered an *OVEINV* when its actual risk group is higher than the predicted risk group.

When the risk model is estimated by OLS regressions, the same acquisitions can be classified into 2 categories by comparing the predicted target R&D intensity to the actual. The residuals in the OLS regression represent the suboptimal risk level of acquisitions (*RESID*). If the actual risk level, $Risk_i$, is not as the same as the predicted risk $\overline{Risk_i}$, the acquisition risk is considered to be 'suboptimal' as shown in model 6-3

$$RESID_i = Risk_i - \overline{Risk_i} \qquad \textbf{Model 6-3}$$

A positive (negative) RESID represents an over-/under-risk acquisition. The magnitude of RESID is a measure of risk 'suboptimality' in the acquisition decision.

6.5.3 Estimating acquirer long-term post-acquisition performance

Step three involves estimation of the acquirer shareholder wealth gains over three post-acquisition years using the standard event study methodology that incorporates a range of benchmarks suggested in the literature.

Event study methodology is widely used and well documented in the financial economic literature. It is used to assess the impact of an economic event or a firm-specific event on the value of a firm. The earliest work on the event study methodology is probably by Dolley (1933) who used it to examine stock splits. The event study approach has been widely used in studies examining the valuation impact of a corporate events such as M&As. The event study methodology can be seen as a five-step process: event definition; sample selection; calculation of the expected and abnormal returns; aggregation of abnormal returns and testing the significance and presentation and interpretation of the empirical results. The following section discusses several controversial issues relating to event study methodology.

6.5.3.2 Event window

The event window in this study is three years after the acquisition effective month, 0. The reason why a 3-year horizon is adopted is because firstly, acquisitions have a strong and extended impact on firm profile and this can be reflected in multi-year firm performance. Secondly, evidence shows that short-term measurement of abnormal returns does not capture the full stock market reaction to an event (Rau and Vermaelen, 1998; Agrawal and Jaffe, 2000). Some studies have extended the event window to 3 years and only a few to 5 years to test market efficiency. However, the longer the horizon is, the more sensitive is the long-term performance test to the methodology employed and the more controversial is the reliability of the results. Furthermore, long event windows also are vulnerable to the impact of confounding events (see Sudarsanam, 2003, Chapter 4). Therefore, following the majority of long-term event studies, e.g. Barber and Lyon (1997), Rau and Vermaelen (1998), Kohers and Kohers (2001), Datta *et al* (2001), Sudarsanam and Mahate 2003 and Conn *et al* (2005), this study adopts a 3-year event window.

6.5.3.3 Benchmark model

To assess whether a firm is performing unusually well or poorly under the effects of a corporate action, researchers need to specify the performance they expect in the absence of such an event, thus providing a benchmark against which sample firm performance can be compared. To be specific, the event period expected return on stock *i* conditional on an event is expressed as follows:

$$E(r_i(t)|event) = \delta + E(r_i(t)) \qquad \textbf{Equation 6-11}$$

where δ is the component of return attributable to the event and $E(r_i(t))$ is the unconditional t-period expected return on stock i. Event studies estimate the magnitude of δ to evaluate the valuation effect of the event. In event studies in which the event window t is short, the value impact of the event is likely to be large. The estimate of δ is typically not sensitive to the choice of asset pricing model used to determine $E(r_i(t))$. $E(r_i(t))$ is larger in long-horizon event studies and it is difficult to sharply divide average realized returns into two components: the expected return, and the corporate event specific return.

There are mainly two approaches to model expected performance: normative models such as the Capital Asset Pricing Model (CAPM), and positive models such as the control portfolio model and control firm model. Positive models predict post-event performance based on event firms' pre-event characteristics. Both approaches are employed in extant empirical studies.

Fama (1998) argues that asset pricing models do not completely describe expected returns. For example, if an event sample is tilted toward small stocks, using CAPM which only adjusts for market risk as a benchmark can produce spurious abnormal returns. Fama (1998) recommends firm-specific models that capture pre-event characteristics of sample firms. Barber and Lyon (1996) state that pre-event characteristics of firms can lead researchers to expect that sample firms will experience above (or below)-average performance after an event, even before they consider the impact of the event under consideration. For example, if certain industries have experienced unusual growth in return on asset (ROA) during the sample period, it might be reasonable to expect the sample firms in those industries to experience a similar growth in ROA after the event.

Barber and Lyon (1997) document that a control firm approach which uses one firm of similar characteristics as the sample firm as a benchmark yields better specified test statistics than the control portfolio approach which uses a portfolio of firms of similar characteristics as a benchmark, and yields better results than asset pricing models since the control firm approach alleviates new listing[118], rebalancing[119], and

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[118] New listing bias arises because in event studies of long-run abnormal returns, sample firms generally have a long post-event history of returns, while firms that constitute index (or control portfolio) typically include new firms that begin trading subsequent to the event month. This is less likely to happen with a control firm approach since both the sample and control firm must be listed in the identified event month (Barber and Lyon, 1997).

skewness biases[120] while the other two approaches cannot. This study therefore adopts a control firm approach[121].

Summarising the existing literature, this study uses four firm characteristics: industry, size, BEME, and momentum. Industry is considered an important factor because as Kohers and Kohers (2001) state, that high-tech firms have a distinctive high growth nature which is only captured by industry classification. Size and book-to-market effect have been argued to capture much of the cross-section of average stock returns (Banz, 1981; Fama and French, 1992; Fama and French, 1995; Ikenberry *et al*, (1995); Barber and Lyon (1997); Strong and Xu, 1997).

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[119] Rebalancing bias arises because the compound returns of a control portfolio, such as an equally weighted market index, are typically calculated assuming periodic (generally monthly) rebalancing, while the returns of sample firms are compounded without rebalancing. This is less likely to happen with the control firm approach since both sample firms and control firms are calculated without rebalancing (Barber and Lyon, 1997).

[120] Skewness bias arises because long-run abnormal returns are positively skewed (see Barber and Lyon, 1997 for more discussions). This is less likely to happen with the control firm approach since both sample and control firms are equally likely to experience large positive returns (Barber and Lyon, 1997).

[121] The control firm approach is not without any problems. For example, like any other benchmark models, it is subject to model misspecification problem (Lyon *et al*, 1999). If the benchmark model is not properly specified, for instance, some important pre-event characteristics are not included in the benchmark, the resulting abnormal returns could still be spurious. Cowan and Sergeant (2001) state that the control firm approach is not able to eliminate the bias from the interaction of skewness bias and sample size bias. A large sample is more likely to have normally distributed returns than a small sample. The test statistics for a non-normally distributed stock returns arising from a small size are more likely to be mis-specified. This creates sample size bias.

A few studies, such as Carhart (1997), find persistence in stock prices, which they call 'momentum'. They find that stock momentum could partially explain the post-event abnormal returns up to 3 or even 5 years. Rau and Vermaelen (1998) note that the market has a tendency to extrapolate the bidder's past performance into the future. Therefore, this study uses industry, size, book-to-market and momentum to identify matching firms.

Industry classifications are based on Datastream industrial classifications which exist at six levels[122]. For individual firms, Datastream has industrial classification level 6 (coded as INDC6), level 5 (coded as INDC5), level 4 (coded as INDC4), and level 3 (coded as INDC3)[123]. The most specific and least general level is level 6 (Datastream code INDC6). In this thesis, industry classification is based on INDC4. INDC6 or

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[122] Level 1, is the total market.

Level 2 comprises 5 sectors: total non-financials; total non-financials, excluding mineral extraction; mineral extraction; financials; investment trusts

Level 3 comprises 7 sectors: mineral extraction; general manufacturers; consumer goods; services; utilities; financials; investment trusts.

Level 4 classification, comprises up to 38 sectors, based on the FTSE-Actuaries system.

Level 5 comprises up to 76 FTSE-Actuaries sub-sectors. Various level 4 sectors are broken down at this level into more detailed descriptions used by the London Stock Exchange.

Level 6 comprises up to 83 Datastream sub-sectors. These level 6 groups have been devised by Datastream to contain more detailed descriptions about industry sectors than those provided at level 4 and level 5.

[123] Datastream indicates that at levels 4, 5 and 6, the number of sectors and sub-sectors will vary over time. I therefore download each level for each year over 1990-2002 for all the sample firms in this thesis as well as the universe of firms that are used to construct benchmarks. The result shows none of those firms changes industry classification.

INDC5 are more specific than INDC4. If industry classification were to be based on INDC6 or INDC5, it is unlikely that many firms would be left to choose from in some sectors once the industry filter had been applied. This would have made size, BEME and momentum filters invalid for many sample firms. Therefore, this study uses the more general industry classification INDC4.

Size is based on the market value of equity (Datastream code 'MV') at the end of month -2 prior to acquisition announcement month, 0. BEME has been defined in Section 6.2.1.3. Briefly, it is the ratio of acquirers' book value of equity in the accounting year prior to acquisition announcement relative to market value of equity at the month end of month -2 prior to acquisition announcement month, 0. A five-month accounting lag[124] is considered when matching the book value to the market value.

Following Carhart (1997), stock price momentum is calculated as the 11-month average monthly returns lagged by one month (month -12 to month -2).

To incorporate all the firm characteristics with equal weight, Jegadeesh (2000) employs a distance metric. Datta *et al* (2001) also use distance metrics to find matching firms for their sample of acquirers. The following equation formulates the distance metric for one sample firm:

$$Distance_j = \sum_{i=1}^{N} \frac{\left| X_{sample}(i) - X_j(i) \right|}{\sigma_i}$$ **Equation 6-12**

where

j = jth universe firm which is used to construct the benchmark;

[124] See Section 6.2.1.3 for discussions about accounting lag.

i = ith characteristic of a sample firm, such as size, book-to-market and momentum;

N = total number of matching characteristics for a sample firm;

$X_{sample}(i)$ = value of the characteristic i for a sample firm;

$X_j(i)$ = value of the characteristic i for a universe firm, j;

σ_i = cross-sectional standard deviation of characteristics i of universe firms.

This thesis employs acquirer industry classification, size, BEME and stock price momentum as the characteristics. Given that it is impossible to apply industry classification to Equation 6-12, the sample firm is first matched on industry factor, and then distance metrics are calculated to identify the best-fit matching firm. For example, consider a sample firm i from the biotechnology industry with values for its size, book-to-market ratio and stock price momentum being, 10 million, 0.5 and 0.3. The universe of firms, which are used to construct the benchmark are all the firms in Datastream. Firstly, all the universe firms that are in the biotechnology industry are identified (let's say there are 120 firms excluding the sample firm). After imposing all the constraints that are discussed below, there are 100 firms left to construct the benchmark. The standard deviations of size, BEME and momentum for the 100 firms are 0.1, 0.2 and 0.4. We then randomly choose one firm, j, out of these 100 firms and firm j's size, BEME and momentum ratio are 15 million, 1.1 and 0.5, respectively. The distance metric of the sample firm i relative to the universe firm, j, is as follows:

$$Distance_j = \frac{|10-15|}{0.1} + \frac{|0.5-1.1|}{0.2} + \frac{|0.3-0.5|}{0.4} = 53.5$$

Similarly, the distance metrics for all the rest of the remaining 99 firms are calculated. The one with the lowest distance metric value indicating closest match to the sample firm is picked as the benchmark firm, or the matching firm. In line with most of the existing studies on long-term acquisition performance, such as Barber and Lyon (1997), Mitchell and Stafford (2000), the matching firm is re-identified once a year to control for the changing risk characteristics of the sample firm with time. Given that this study examines acquirers' 3-year post-acquisition performance, an acquirer will have altogether 3 matching firms to compare with their own stock return performance for the whole 3 years after the acquisition.

The universe of firms used to construct the various benchmarks are all of the Datastream firms, both UK and International, listed on the London Stock Exchange. In this study several constraints determine whether or not universe firms are included in the benchmark portfolios or considered as matching firms.

1. Firms have to have valid characteristic data in the effective month of the corresponding sample firm. In particular, firms have to have size data at the end of month -2 prior to the acquisition announcement month, 0.
2. Following Fama and French (1992) and Fama and French (1993), firms without positive market value of equity or positive book value of equity (BEME) are excluded from the analysis. This is because the interpretation of negative BEME is problematic. For the same market value, a higher book value of equity (BE) signifies a lack of growth opportunities. However, it is impossible to impose the same interpretation on the BEME ratio when the BE is negative.

3. Firms with stock return data which does not extend to more than one year prior to acquisition announcement are excluded. This is to avoid new listing bias[125] and gives us a fair data for an assessment of momentum.
4. Furthermore, a firm is excluded if it is already in the sample and has an acquisition between -36 months and 36 months of the effective month of the sample acquisition. This is to avoid contamination of the influence of prior or later acquisitions on stock performance (see Lyon *et al*, 1999 for more discussions).

Having identified the matching firm, the next step is to calculate the stock returns. As discussed above, each acquirer will have three matching firms for 3 years after the acquisition, i.e., one for 12 month starting from acquisition effective month (month 0), one for 12 month starting from month +12 and the other for 12 month starting from month +24. Monthly returns for the following 12 months are then calculated for each of these matching firms. The method of calculating the stock returns is described in the next section.

6.5.3.4 Buy-and-hold abnormal returns

Monthly return data is argued to be more appropriate than daily return data in long-term event studies because it can reduce many of the problems encountered using daily return data, such as overstatement of the magnitude of abnormal returns because returns are compounded daily (Roll, 1983; Kennedy and Limmack, 1996).

There are three main ways of calculating long-term stock returns: buy-and-hold abnormal returns (BHARs), cumulative abnormal returns (CARs) and the calendar time approach. BHARs give the actual investment returns an investor would achieve from

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[125] See footnote 118 for the definition of new listing bias.

buying equal dollar amounts of N securities and holding the shares for a period of time T (Roll, 1983), while CARs assumes portfolio rebalancing every month[126]. Since monthly rebalancing is so costly this is not a realistic strategy. Furthermore, Barber and Lyon (1997) argue that CAR gives a biased estimate of long-run buy-and-hold investment returns, which is termed as 'measurement bias' by Barber and Lyon (1997)[127]. Measurement bias can lead to incorrect inferences regarding investment strategy[128]. The calendar time approach tracks the performance of an event portfolio in calendar time relative to either an explicit asset-pricing model or some other

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[126] When calculating CARs, the portfolio return for every month is generated by taking the average of all the stock returns in the portfolio. The monthly portfolio returns are then used to calculate the portfolio holding period return. The monthly averaging indicates that the portfolio is rebalanced every month in actual stock investment by selling securities with positive returns and buying securities with negative returns to achieve a portfolio structure the same as when it was first constructed.

[127] It is argued that bad model problems are more acute with long-term BHARs because of the compounding effect of the BHAR approach (Fama, 1998; Mitchell and Stafford, 2000). If a benchmark model is not appropriate, i.e., a bad model, compounding the expected returns can exacerbate the error. Mitchell and Stafford (2000) state that BHARs can give false impressions of the speed of price adjustment to an event because BHARs can grow with the return horizon even when there is no abnormal return after the first period.

[128] Barber and Lyon (1997) illustrate that a sample of firms that all have 0 annual buy-and-hold abnormal returns calculated relative to a market benchmark has a corresponding 12-month mean CAR of +5%. Barber and Lyon suggest that researchers who restrict their analysis to CARs and ignore the analysis of BHARs could conceivably conclude that the sample in question earned long-term abnormal returns when in fact it did not.

benchmark[129](Fama, 1998). By aggregating the returns on sample firms into a single portfolio, calendar time approach does not precisely measure investor experience as precisely as BHARs (Lyon *et al*, 1999). Loughran and Ritter (2000) suggest that calendar time abnormal returns lack power because they weigh each month equally regardless of the number of observations in the month. They recommend BHARs. This study uses BHAR[130]. $BHAR_i$ is calculated as:

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[129] Suppose the event window is three years. For each calendar month, calculate the abnormal return on each stock that had an event in the last three years. Then average the abnormal returns for the calendar month across stocks to generate the abnormal return for the month on the portfolio of stocks with an event in the last three years. The portfolio is reformed once a month by dropping the stocks that reach the end of 3-year period and adding all new stocks that just start their 3-year period. The average abnormal return for the entire sample is the time series average (CTAR) and the *t*-test is calculated using the standard deviation of the time series.

[130] As pointed out by Fama (1998), estimating statistical significance with BHARs and CARs are problematic because the standard t-statistic do not adequately account for potential cross-sectional dependence in returns. Cross-sectional dependence means that the returns of sample firms are correlated, which can lead to mis-specified test statistics. Cross-sectional dependence is likely to happen when sample firms exhibit calendar time clustering or there are overlapping periods of return calculation for the same sample firm. Lyon *et al* (1999) recommend that calendar time approach can eliminate cross-sectional dependence of sample firms by aggregating the returns on sample firms into a single portfolio thus avoiding the problem of the correlation of returns. Conn *et al* (2005) use all three approaches and find that they produce similar results both in terms the magnitude of abnormal returns and statistical significance. In Conn *et al*'s sample, there are 87% (3340 out of 3842 acquisitions) acquisitions are multiple acquisitions. Given such a high ratio of multiple acquisitions in the sample, Conn *et al* still find that BHARs and CTARs generate similar results. In the sample of this thesis, 41% (235 acquisitions out of 578 acquisitions) are multiple acquisitions, much less than that in Conn *et al*'s sample. It is therefore expected BHARs reported in this thesis may not be significantly biased.

$$BHAR_i = \prod_{t=1}^{T}(1 + R_{i,t}) - \prod_{t=1}^{T}(1 + R_{benchmark,t})$$ **Equation 6-13**

where month $t = 1$ is the first month following the effective month, $R_{i,t}$ is the return on stock i on month t, and T is the three-year anniversary month of the effective month. If the sample firm is delisted before T, this causes survivorship bias to the portfolio BHAR at T because the delisted companies are not included in the portfolio to calculate portfolio BHAR at T. The BHAR thus generated does not reflect real portfolio performance. Baker and Limmack (2001) suggest three ways of dealing this survivorship bias problem: excluding those firms which do not survive the whole examination period, replacing delisted firm returns following delisting with 'proxy returns' such as returns of the benchmark, and replacing with a zero return. The first approach decreases the sample size and brings more survivorship bias. Therefore the later two approaches are more favoured by researchers than the first. Baker and Limmack find that the two approaches do not generate results that are significantly different from each other. This study uses both approaches and also finds that these two approaches yield portfolio returns that are not significantly different from each other. Because the second approach appears more complicated than the third, I explain the second approach and report the acquirers' post-acquisition returns calculated using this approach. If the sample firm is delisted before T, the return from the benchmark is imputed. However, if the benchmark firm is delisted before T, the return from the FTSE All Share index (Datastream code 'LFTALLSH') is used in substitution.

The BHAR for the portfolio of sample firms is then calculated as:

$$ABHAR_T = \frac{1}{N}\sum_{i=1}^{N} BHAR_{i,T}$$ **Equation 6-14**

where $ABHAR_T$ is the equally weighted BHARs[131] for firm i over time period T. N is the total number of stocks in the portfolio.

6.5.3.5 Significance testing

When the distribution of returns is not normal, one solution is to emphasize the results of non-parametric tests, including those that emphasize median values for tests of proportion (Limmack, 2003). The null hypothesis in testing for abnormal returns is that the given event has no impact on the behaviour of security returns, i.e., the abnormal return is 0. This study applies three test methods including both parametric and non-parametric tests for significance testing of the long-term abnormal returns: Student's t-test, Fisher's sign test, and Wilcoxon signed-rank test.

Student's t-test

Student's t-test is used to test the null hypothesis that the population mean of BHARs [132] is equal to zero. The usual assumptions for Student's t-test are

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[131] An alternative approach is to calculate value-weighted returns (Fama 1998). These two approaches have different implications. Equally-weighted returns reflect whether on average event firms experience abnormal returns while value-weighted returns indicate whether an investor holding the value-weighted portfolio of event firms will earn abnormal returns. This thesis aims to find out the average performance of acquirers in a certain risk group. Hence, an equally weighted approach is adopted.

independence[133] and normality of BHARs[134]. Independence of the BHARs implies no correlation across the BHARs of different securities. This will generally be the case if there is no clustering, and there is no overlap in the event windows of the included securities (Campbell *et al,* 1997, Chapter 4). Given the BHARs for a sample of N event firms, the student t-statistics is computed as follows:

$$t = \frac{\overline{BHAR_h}}{\sigma(BHAR_h)/\sqrt{N}}$$ **Equation 6-15**

where $\overline{BHAR_h}$ is the mean of the sample abnormal returns, h is the holding period, and $\sigma(BHAR_h)$ is the cross-sectional standard deviation of the abnormal returns for the sample of N firms.

Fisher's sign test

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[132] Student's t test can test not only BHARs but also other types of returns. So can the other statistics discussed below. The reason why BHARs is used here is because this thesis uses BHARs as a performance measure.

[133] Footnote 130 has explained that cross-sectional dependence can cause mis-specified t-statistics and a remedy to it is using the Calendar time approach. Mitchell and Stafford (2000) also recommend an approach to adjust t-statistics to incorporate the cross-sectional dependence of returns.

[134] A remedy to this is to use skewness-adjusted t-statistics. Johnson (1978) develops skewness-adjusted t-test to correct the misspecification error found in the student's t-test that is caused by the skewness of the population distribution. This thesis calculates both student's t-statistics and Johnson's skewness-adjusted t-statistics and finds no significant difference between these two. Therefore only student's t-test is reported in the thesis.

Fisher's sign test is a nonparametric test which is free of specific assumptions concerning the distribution of returns. It requires that the BHARs are independent[135] across securities and follow a continuous distribution, and that the expected proportion of positive BHARs under the null hypothesis is 0.5, i.e., the median of the BHARs is 0. The basis of the test is that under the null hypothesis it is equally probable that the abnormal returns will be positive or negative. The test statistic is calculated as follows:

$$B = \sum_{i=1}^{N} I(BHAR_i > 0) \qquad \textbf{Equation 6-16}$$

where the indicator, $I(BHAR_i > 0)$, equals 1 if the BHAR on the *i*th firm is greater than 0, 0 otherwise. N is the total number of firms in the sample. At the chosen significance level a, the null hypothesis is rejected in favour of the alternative of a non-zero median if $B \geq b(a/2, N, 0.5)$ or $B \leq b(a/2, N, 0.5)$ in a two tail test, or in favour of a positive median if $B \geq b(a, N, 0.5)$, or in favour of a negative median if $B \leq b(a, N, 0.5)$ in one-tail test. The constant $b(a, N, 0.5)$ is the upper a percentile point of the binomial distribution with sample size N and type 1 error probability of 0.5.

A weakness of Fisher's sign test is that it may not be well specified if the expected proportion of positive BHARs is not 0.5 (Campbell *et al*, 1997, Chapter 4). This does not meet the assumption of this test that the median of the BHARs is 0. A nonparametric rank test may overcome this shortcoming.

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[135] As discussed in footnote 130, cross-sectional dependence of stock returns is one of the problems in long-term event studies. Correlated BHARs lead to mis-specified test statistics for Student's t test. I suspect that correlated BHARs can also create biases for the nonparametric test statistics.

Wilcoxon signed-rank test

As noted in the previous section, a rank test may overcome the shortcoming of the sign test that the expected proportion of positive abnormal returns can differ from one half even under the null hypothesis. The Wilcoxon signed-rank test also requires the mutual independence of abnormal returns[136]. In addition, it requires the distribution of the abnormal returns to be symmetric, but Fisher's sign test does not. In this sense, the Wilcoxon signed-rank test is considered as more stringent than Fisher's sign test (Hollander and Wolfe, 1999, chapter 3). The test statistic is calculated as follows:

$$W = \sum_{i=1}^{N} R_i I_i (BHAR_i > 0) \qquad \textbf{Equation 6-18}$$

where R_i is the rank given to $|BHAR_i|$, I_i is the indicator which takes on the value of 1 if $BHAR_i$ is positive and 0 if negative. At the chosen significance level of a, the null hypothesis is rejected in favour of the alternative non-zero median if $W \geq t_{a/2}$ or $W \leq \frac{N(N+1)}{2} - t_{a/2}$ in a two-tail test, or in favour of positive median if $W \geq t_a$, or in favour of negative median if $W \leq \frac{N(N+1)}{2} - t_a$ where the constant t_a is chosen to make the type I error probability equal to a . Its value can be found in a statistics table.

In addition to the above three commonly used significance tests, empirical studies also employ the bootstrapping approach. Ang and Zhang (2002) document that Fisher's sign test has higher power than computation-intensive bootstrapping-based

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[136] See footnote 130.

tests do for longer time horizons. This study therefore does not employ the bootstrapping approach but rather uses the three tests described above.

6.5.4 Estimating the impact of optimal/suboptimal acquisition risk on acquirer shareholder wealth gains.

Step four involves performing univariate and multiple regression analyses of the differences in wealth gains among acquisitions of different risk categories generated in stage two.

6.5.4.1 Univariate analysis

To analyse the BHARs of different acquisition risk groups, I conduct a univariate analysis. Such an analysis explores each variable in a data set separately (Kachigan, 1986). It looks at the range of values, as well as the central tendency of the values. It describes the pattern of response to the variable.

Specifically, I analyse 3-year BHARs of different acquisition risk groups and compare their differences to examine whether suboptimal-risk acquisitions underperform optimal-risk acquisitions as predicted by the empirical risk model 6-1. Following Model 6-2 or Model 6-3, acquisitions can be classified into under-risk investment (UNDINV), optimal-risk investment (OPTINV) and over-risk investment (OVEINV). The BHARs for each group are calculated and differences of BHARs between under-risk acquisitions (UNDINV) and optimal-risk acquisitions (OPTINV), and between over-risk acquisitions (OVEINV) and optimal-risk acquisitions (OPTINV) are calculated. When acquisition risk as measured by target industry R&D intensity, acquisition risk may be very close to but not exactly the same as that predicted by the empirical risk model (Model 6-1). Therefore, a range of (-10%, +10%) is allowed for statistical noises. This means that if the actual acquisition risk as measured by target R&D intensity is within the [-10%, 10%] range of the value of the predicted acquisition risk, this acquisition is still considered as an optimal-risk acquisition.

Student's t test is used to test the mean of the 3-year BHARs of each acquisition risk group. Fisher's sign test and Wilcoxon signed-rank test are employed to test the median of the 3-year BHARs of each risk group. Student's t test is again applied to test the mean difference between the 3-year BHARs of the two acquisition risk investment groups. Wilcoxon rank sum test is used to test the median difference between the 3-year BHARs of the two groups.

Wilcoxon rank sum test is used in place of a two-sample t test when the populations being compared are not normal (Hollander and Wolfe, 1999, Chapter 3). When there are two samples of size of n_1 and n_2 respectively, the test combines the two samples into one sample of size $n_1 + n_2$, sorts the result, and assigns ranks to the sorted values. Letting T be the sum of the ranks for the observations in the first sample, if the two populations have the same distribution then the sum of the ranks of the first sample and of those in the second sample should be close to the same value. The null hypothesis is that the two distributions are the same. The test statistic is calculated as follows:

$$z = \frac{T_1 - \left[\frac{n_1 n_2 + n_1(n_1 + 1)}{2}\right]}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}} \qquad \textbf{Equation 6-19}$$

6.5.4.2 Multiple regression analysis

Univariate analysis provides some evidence with regard to the impact of optimal/suboptimal acquisition risk on post-acquisition performance. However, such an analysis does not isolate other factors that may also have influence on firm performance. To obtain more robust results, a multiple regression analysis is adopted. Multiple regression analysis allows the assessment of the relationship between one dependent variable and several independent variables (Tabachnick and Fidell, 1996, Chapter 5). It gives the impact of each independent variable on the dependent variable while isolating the influences of other independent variables. Given that BHARs data is continuous data, an OLS regression is adopted in this study to estimate the empirical performance model (Model 6-4) as shown below. The characteristics of OLS regression have been discussed in Section 6.5.1.2

$$BHAR_i = \beta_0 + \beta_1 UNDINV_i + \beta_2 OVEINV_i + \beta_3 NONCASH_i + \varepsilon_i$$

Or **Model 6-4**

$$BHAR_i = \beta_0 + \beta_1 RESID_i + \beta_2 NONCASH_i + \varepsilon_i$$

where $BHAR_i$ is 3-year buy-and-hold abnormal returns for acquirer *i*. The variables have been defined in Table 6-1 in Section 6.2.2, as well as in Table 6-1.

6.5.5 Additional test of post-acquisition performance on risk incentives

As has mentioned in Chapter 2, 3, 4 and 5, conventional empirical finance studies try to establish a direct link between firm performance and executive wealth, or corporate monitoring mechanisms without much consideration of manager decisions on project risk. Even those behavioural finance studies such as Hayward and Hambrick (1997) that argue that managers can have excessive risk taking behaviour but only examine the relationship between firm performance and the degree of behavioural biases. To produce results comparable with those studies and further prove that the two-stage analysis suggested by this study discloses better information with regard to the efficiency of corporate governance, this section adopts the conventional approach. Following the existing literature, the arguments for the relationship between post-acquisition performance and each risk incentives are as follows.

Fixed compensation is not tied to firm performance and provides little incentive for managers to align their interests to those of shareholders. Summarizing six papers which cover the sample period from 1974 to 1993, Conyon *et al* (1993) conclude that the relationship between cash compensation and stock market performance is very weak in both UK and US. A recent literature summary by Bebchuk and Fried (2004, Part III) generally reports a weak association between firm performance and fixed pay. Annual bonus can be manipulated by the choice of accounting techniques that managers can use to shift income from future to the current accounting period. Managers may set undemanding performance targets, they may lower performance targets when it appears that management will not achieve the targets necessary for the bonuses to be paid, etc. In summary, accounting-based annual bonus can actually induce counter-productive behaviour. Therefore, acquirer post-acquisition performance is expected to be weakly associated with cash compensation.

As discussed in Section 2.3.2.3 of Chapter 2, LTIP cash rewards managers when they meet the performance targets within the specified multi-year time horizon. Therefore, theoretically LTIP cash can motivate managers to improve firm performance.

The logic behind LTIP shares and stock options is that the firm only pays for performance. For an option vesting in two years with a two year exercise period and a strike price of £20 per share, assuming a current stock market price of £10 per share, the CEO must double the firm's stock price during the next four years in order to reap any returns from the options. Stock options can thus contribute to better firm performance by offering managers incentives to improve firm performance. Datta *et al* (2001) find this evidence by examining the relationship between post-acquisition performance and executive equity-based compensation. Therefore, equity delta and option vega, measures of the incentive provided by equity-based wealth as discussed in Section 2.3.3 of Chapter 2, are expected to be positively related to firm performance. As discussed in Section 2.3.4.2, Mishra *et al* (2000) suggest a nonlinear relationship between firm performance and equity delta. A low equity delta is positively linked to firm performance while a high equity delta is negatively linked to firm performance. Mishra *et al*'s argument is consistent with Morck *et al* (1988)'s argument that the relationship between firm performance and equity ownership is nonlinear. Ross (2004) argues that a high-level of managerial wealth intensifies managerial risk aversion and diminishes the incentive alignment effect provided by equity-based wealth (see Section 2.4). It is therefore expected that a high level of managers' wealth attached to their employment firms do not positively linked to firm performance.

As argued in Chapter 3, managerial behavioural biases lead to value destruction for acquirer shareholders. The proxies for behavioural biases such as past performance, glamour status, and media praise to be negatively related to acquirer post-acquisition performance.

As suggested in section 6.2.1.4 of Chapter 6, debt provides a degree of corporate control over managers. Increased debt reduces free cash flow and so limits the managerial discretion of wasting corporate resources and thus decreases agency costs

(Jensen 1986; Weir *et al*, 2002; Novaes, 2003). For a sample of 990 acquisitions between 1962 and 1990, Maloney *et al* (1993) find that bidders with higher leverage ratios have higher announcement period abnormal returns. Therefore, financial leverage is expected to be positively related to firm performance.

Moeller *et al* (2004) report that larger acquirers pay more for acquisitions than small acquirers do. The premium paid increases with firm size after controlling for firm and deal characteristics. Consequently, large firms make large acquisitions that result in large dollar losses. They find that small acquirers, although making small and less risky acquisitions, gain value for their shareholders. Roughly, shareholders from small firms earned $9 billion from acquisitions made during 1980-2001, whereas shareholders from large firms lost $312 billion.

There are different views with regard to the impact of relative size of acquirers to targets (Sudarsanam *et al*, 1996). Bidder shareholders gain more when the firm takes over a relatively small target. The smallness of the target facilitates integration of the target with the bidder and helps realize the expected synergies underpinning the takeover. The alternative argument is that bidders are more generous in their bid premiums for small targets and, thus transfer more acquirer's wealth to the target, causing acquirers to loose value.

The argument that noncash payment can affect acquirers' post acquisition performance has been discussed in Section 6.2.2.3. The above arguments generate a model which directly examines the relationship between post-acquisition performance and various risk incentives without considering managers' choices regarding acquisition risk. The model is formulated as below:

$$
\begin{aligned}
BHAR_i = {} & \alpha_0 + \alpha_1 FAB_i + \alpha_2 LTIPCASH_i + \alpha_3 DELTA_i + \alpha_4 DELTA_i^2 \\
& + \alpha_5 VEGA_i + \alpha_6 DELTA_i * WEALTH_i \\
& + \alpha_7 VEGA_i * WEALTH_i \\
& + \alpha_8 PAST_i + \alpha_9 BEME_i + \alpha_{10} MEDIA_i \\
& + \alpha_{11} LARSHR_i + \alpha_{12} NEXE_i + \alpha_{13} NONDUAL_i + \alpha_{14} REM_i \\
& + \alpha_{15} LEV_i + \alpha_{16} MV_i + \alpha_{17} RELSIZ_i + \alpha_{18} NONCASH_i + \mu_i
\end{aligned}
$$

Model 6-5

where $BHAR_i$ is acquirer 3-year buy and hold abnormal returns. See Section 6.5.3 for a discussion of how to calculate the BHARs. All the independent variables have been discussed and defined in Section 6.2.

6.5.6 Other statistical test: Pearson's Chi-square test

Pearson's Chi-square test is used to examine the differences between the following variables for the high-tech acquisition and the low-tech acquisition groups: the CEO-COB non-duality variable (NONDUAL), the remuneration committee variable (REM), and wealth components as a percentage of the total wealth.

Pearson's Chi-square test is used to assess the relationship between 2 discrete variables (Tabachnick and Fidell, 1996, Chapter 3). The null hypothesis tested is that the variable on the row is independent of the variable on the column. The chi-square statistic (χ^2) is computed as:

$$\chi^2 = \sum_{ij} \frac{(fo - Fe)^2}{Fe}$$

Equation 6-19

where fo is observed frequency and Fe represents the expected frequency in each cell. Summation is carried out over all of the cells in a two-way table. The expected frequencies for a cell are generated from dividing the multiplication of the row sum and the column sum by the grand total. If the χ^2 is larger than the critical value, this test rejects the null hypothesis in favour of the alternative hypothesis of general association.

6.6 Summary

This chapter defines variables and describes data sources used as well as sample construction. It also describes how the high-tech acquisition group is constructed and what criteria are used for the selection of the matching low-tech acquisition group. The distribution for both high-tech acquisitions and low-tech acquisitions in the sample of this thesis is also reported.

The research methodology used in this study includes five steps of analyses. They are:

1. Estimation of an empirical risk model
2. Identification of suboptimal-risk acquisitions
3. Estimation of acquirer long-term post-acquisition performance
4. Estimation of the impact of optimal/suboptimal acquisition risk on acquirer post-acquisition performance
5. Testing of the relationship between acquirer shareholder wealth gains and various risk incentives.

In this chapter, empirical models are proposed which correspond to the conceptual risk model (Model 5-1) and conceptual performance model (Model 5-2). Various analysis methods, such as statistical tests, logistic and OLS regression models, univariate analysis, as well as the event study methodology are explained and their use in the analysis justified.

Chapters 7 and 8 present and discuss the results of the five-stage analysis. Chapter 7 focuses on the results produced by the risk model and Chapter 8 focuses on results produced by the performance model.

Chapter 7

Determinants of Acquisition Risk

7.1 Introduction

This chapter aims to answer research question Q1 raised in Chapter 5. The research question is:

Q1: What are the factors that drive managers to undertake risky projects?

The literature review chapters (i.e. Chapter 2, Chapter 3 and Chapter 4) suggest that managers' wealth, behavioural biases and corporate monitoring mechanisms may have some influence on managers' risk taking behaviour. Using corporate acquisitions as a context, Chapter 5 develops hypotheses concerning the association between the acquisition risk and various factors that may impact on managers' attitudes towards it. Briefly, fixed compensation and annual bonus are postulated to be negatively related to the riskiness of acquisitions pursued by managers. It is hypothesized that there is a concave relationship between acquisition risk and equity delta (or LTIP delta, stock option delta, share delta). The following factors are predicted to have a non-positive relationship with acquisition risk:

- equity delta (or LTIP delta, stock option delta, share delta) at a high level of managerial wealth
- stock option vega at a high level of managerial wealth

The following factors are hypothesized to be positively associated with acquisition risk:

- LTIP cash
- stock option vega

- behavioural biases measured by good past performance, acquirers' glamour status and media praise

In addition, under the control of corporate monitoring devices such as external blockholders, institutional blockholders, a board dominated by non-executive directors, a non-executive chairman of board, as well as a remuneration committee, the selected acquisitions are more likely to reflect the optimal risk level.

Chapter 6 defines the above variables and formulates the empirical risk model (Model 6-1) as well as the methodology used test this model. This chapter reports the results of the empirical analyses. The sample distribution of high-tech acquisitions and low-tech acquisitions has been presented in Section 6.4 of Chapter 6. Section 7.2 analyses the characteristics of both high-tech acquisitions and low-tech acquisitions over the two sample periods 1993-1997 and 1998-2000. Section 7.3 then proceeds to report the descriptive statistics for managerial wealth variables, behavioural bias variables, and corporate monitoring variables for the two sample periods. Section 7.4 describes the output of the regression estimation of the empirical risk model, Model 6-1, and gives an overview of the factors that drive managers to select risky acquisitions. Section 7.5 provides the chapter summary.

7.2 Sample characteristics for acquisitions

This section discusses the following characteristics of acquisitions: target industry R&D intensity (TRD), acquirer size (MV), transaction value (TV), relative size of acquirer versus target (RELSIZ), target's public company status, method of payment and acquirer high-tech status. The relevant statistics are reported in Table 7-1. There are 285 acquisitions in the sample period 1993-1997 (Panel A), among which 124 are high-tech, high-risk acquisitions and 161 are low-tech, low risk acquisitions. The

Table 7-1 Acquisition-related characteristics for the sample periods 1993-1997 and 1998-2000

Panel A and Panel B show the acquisition-related characteristics of the samples for the period 1993-1997 and 1998-2000 respectively. In both panels, acquisitions are divided into high-tech acquisitions and low-tech acquisitions. TRD = target industrial R&D intensity in %. MV= acquirer market value of equity in £billion. TV = transaction value of an acquisition in £million. RELSIZ = acquirer size relative to target size. TARPUB = target a public company. TARPRI = target a private company. TARSUB = target a subsidiary. CASH = 100% cash as acquisition currency. STOCK = 100% stock exchange as acquisition currency. MIX = mixture of cash, stock and other payment methods. AHI = acquirers in the high-tech industries. ALO = acquirers in the low-tech industries. See Section 6.2 for a detailed discussion of variable definitions. N = number of acquisitions. In parentheses are the t statistics (mean difference), Wilcoxon rank sum test z statistics (median difference) or Chi-Square (χ^2) test Pearson Chi-Square statistics (proportional difference). All the tests are based on two-tailed tests. a, b, c indicate the significance at the 1%, 5% and 10% level respectively.

Panel A: Acquisitions over 1993-1997

	High-tech acquisitions			**Low-tech acquisitions**			**Group difference**	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**
TRD	5.27	4.48	124	1.73	1.67	161	3.54 (12.1)[a]	2.81 (13.1)[a]
MV	0.51	0.06	124	0.55	0.09	161	-0.04 (-0.2)	-0.03 (-1.8)[c]
TV	88.61	3.12	124	26.56	4.00	161	62.05 (0.9)	-0.88 (-1.0)
RELSIZ	74.40	22.74	124	92.64	22.96	161	-18.24 (-0.5)	-0.22 (-0.5)
	N	**No. of acquisitions**	**% of acquisitions**	**N**	**No. of acquisitions**	**% of acquisitions**	**Proportion (χ^2 stat)**	
TARPUB	8	124	6.45	11	161	6.83	-0.38 (0.02)	
TARPRI	72	124	58.06	108	161	67.08	-9.02 (2.5)	
TARSUB	44	124	35.48	42	161	26.09	9.39 (3.0)[c]	
CASH	49	124	39.52	72	161	44.72	-5.2 (0.8)	
STOCK	12	124	9.68	18	161	11.18	-1.5 (0.2)	
MIX	63	124	50.81	71	161	44.10	6.71 (1.3)	
AHI	102	124	82.26	24	161	14.91	67.35 (128.8)[a]	
ALO	22	124	17.74	137	161	85.09	-67.35 (128.8)[a]	

Table 7-1 (continued)

Panel B: Acquisitions over 1998-2000

	High-tech acquisitions			Low-tech acquisitions			Group difference	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**
TRD	4.48	4.30	165	1.20	0.90	128	3.27 (15.0) [a]	3.40 (13.6) [a]
MV	1.02	0.19	165	0.77	0.16	128	0.25 (1.0)	0.03 (1.2)
TV	73.18	5.09	165	43.38	4.50	128	29.80 (1.0)	0.59 (0.7)
RELSIZ	369.43	34.12	165	91.71	22.21	128	277.70 (1.4)	11.91(0.1)
	N	**Sample size**	**% of the sample**	**N**	**Sample size**	**% of the sample**	**Proportion (χ^2 stat)**	
TARPUB	14	165	8.48	11	128	8.59	-0.11 (0.0)	
TARPRI	120	165	72.73	82	128	64.06	8.67 (2.5)	
TARSUB	31	165	18.79	35	128	27.34	-8.55 (3.0) [c]	
CASH	44	165	26.67	68	128	53.13	-26.46 (21.4) [a]	
STOCK	23	165	13.94	3	128	2.34	11.60 (12.0) [a]	
MIX	98	165	59.39	57	128	44.53	14.86 (6.4) [a]	
AHI	119	165	72.12	18	128	14.06	58.06 (97.6) [a]	
ALO	46	165	27.88	110	128	85.94	-58.06 (97.6) [a]	

average target industry R&D intensity (TRD) for high-tech acquisitions is around 5.3% (median around 4.5%). It is on average 3.5% (median 2.8%) higher than low-tech acquisitions. The differences are significant at the 1% level. There are 165 high-tech acquisitions and 128 low-tech acquisitions in the sample period 1998-2000. The mean and median target industry R&D intensity is also significantly (at the1% level) larger with high-tech acquisitions. Thus the high-tech versus low-tech classification as defined by the Securities Data Company M&A database is largely reflective of the underlying R&D intensity of the target firms in these two broad industry groups.

For the 1993-1997 sample, the average high-tech acquisition transaction size (TV) is approximately £89 million and the median is £3.1 million. Low-tech acquisitions are on average around £62 million smaller than high-tech acquisitions but the median target size in low-tech acquisitions is about £1 million larger than in high-tech acquisitions. However neither the mean nor the median is significantly different between the two target groups. Similarly the mean and median values of the acquirer size (MV) in the high-tech acquisition group are very close to those of the acquirer size in the low-tech acquisition group. This however is not by coincidence because acquirer size is one of the criteria used to find the matching low-tech acquisition for each high-tech acquisition. The average acquirer size is about £0.5 billion and the median size is £60 million to £90 million. In the high-tech acquisition group, the relative size of acquirer to target (RELSIZ) on average is about 74 with a median of 23, whereas in the low-tech acquisition group, the ratio has an average of 93 and a median of 23.

In the 1998-2000 sample (Panel B), the average high-tech acquisition transaction size (TV) is approximately £73 million and the median is £5.1 million. The mean and median of low-tech acquisition size are smaller than they are for high-tech acquisitions.

The average market capitalisation of acquirers (MV) in the high-tech acquisition group in the 1998-2000 sample is around £1 billion, twice the size of those acquirers in the 1993-1997 sample. The medians are also twice the size. While both mean and median of acquirer size are larger in high-tech acquisition group than those in low-tech acquisition group, the differences are not statistically significant. In the high-tech acquisition group, the relative size of acquirer to target (RELSIZ) on average is about 369 (median 34). The ratio drops to 92 and 22 respectively in the low-tech acquisition group. However, the difference neither in mean nor median is statistically significant.

For both sample periods, pure cash financing (CASH) is used less frequently in the high-tech acquisitions than it is in low-tech acquisitions, particularly in the 1998-2000 sample which corresponded to the peak of the bull stock market. The difference is significant at the 1% level. This is consistent with the Martin (1996) argument that managers tend not to offer pure cash but to pay with equity when they are buying targets with high growth opportunities. Interestingly, the proportion of acquirers using pure stock offers (STOCK) or offers including stock (MIX) to buy high-tech targets rises from about 60% in 1993-97 to 73% in 1998-2000. On the other hand, the corresponding proportions for acquirers which bought low-tech targets are 55% and 47%. It appears that acquirers of high-tech targets capitalised on their highly valued stocks as the stock market was hitting the peak to buy real assets, whereas the acquirers of low-tech targets had less of an opportunity to do so. Such a strategic use of highly valued equity is consistent with the arguments of Shleifer and Vishny (2003). It is also in line with the empirical finding of Akbulut (2005) that from 1997-2000 when the equity market valuation was historically high, stock-related pay was the dominant mode of payment for acquisitions.

For acquisitions over the period 1993-1997, around 58% of the target firms in the high-tech acquisition group are private firms (TARPRI), 35% subsidiaries (TARSUB) and only 6% public firms (TARPUB). For the sample period over 1998-2000, the ratios are 73%, 19% and 8% respectively. The low-tech acquisition group has a similar composition, since target public or non-public status is one of the criteria for identifying a matching low-tech acquisition for each high-tech acquisition.

For the high-tech acquisition groups in both 1993-1997 and 1998-2000, the vast majority (over 70%) of acquirers are in high-tech industries. Similarly over 80% of acquirers are in low-tech industries for the low-tech acquisition group. But there are more low-tech acquirers in the high-tech acquisition group in 1998-2000 than in 1993-1997. In 1993-1997, the total number of low-tech acquirers who buy high-tech targets is 22, which is around 18% of the total high-tech acquisitions made during the period. The numbers increase to 46 and 28% respectively in 1998-2000. This indicates that there was an increasing tendency for low-tech companies to cross the technology divide and make high-tech acquisitions. It appears that low-tech acquirers seemed to try and cash in on the technology boom of the late 1990s.

7.2.1 Summary

Section 7.2 describes acquisition-related characteristics of the high-tech acquisitions and low-tech acquisitions over the two sample periods 1993-1997 and 1998-2000. Overall, target industry R&D intensity is significantly higher in the high-tech acquisition group than that in the low-tech acquisition group. There is no statistically significant difference between the transaction size, acquirer size, or relative size of acquirer to target between the two-acquirer groups. Pure cash financing is used less frequently in high-tech acquisitions than in low-tech acquisitions, particularly in the

1998-2000 sample which corresponded to the peak of the bull stock market. Over 90% targets are non-public firms. It appears that acquirers are more likely to buy targets of similar technology level although in the later period, 1998-2000, there is an increasing tendency for companies in the low-tech industries to cross the technology divide and make high-tech acquisitions. Low-tech acquirers seemed to try and cash in on the technology boom of the late 1990s.

7.3 Descriptive statistics for risk incentives

This section discusses the descriptive statistics for risk incentives such as managerial wealth components, hubris variables and monitoring mechanisms over the two sample periods, 1993-1997 and 1998-2000. In the 1993-1997 sample, stock option holdings are not considered in the managerial wealth portfolio due to lack of data as discussed in Section 6.4 of Chapter 6. Therefore the reported values of equity delta and total wealth may be under-represented in the sample covering this period.

7.3.1 Wealth incentives

Table 7-2 presents the descriptive statistics for the components of the wealth portfolios of the acquiring companies' board of directors. Panel A reports the data for the acquisitions over 1993-1997 and Panel B reports the equivalent data over 1998-2000. In each panel, acquirers' data for high-tech acquisitions and low-tech acquisitions are reported separately. The overall wealth level for acquirer board of directors in £ terms is broadly similar in the high-tech and low-tech acquisitions groups in 1993-1997 (about £12 million to £14 million). But in 1998-2000 the directors of acquirers who conducted low-tech acquisitions have a much higher mean wealth (about £58 million to

Table 7-2: Summary descriptive statistics for the wealth portfolio of the acquirers' board of directors

This table reports the descriptive statistics for the wealth portfolio of the acquirers' board of directors prior to acquisition announcement. Panel A reports the data for the acquisitions over 1993-1997 and Panel B reports data for the acquisitions over 1998-2000. FAB = the sum of the fixed compensation and annual bonus in £million. LTIP cash = the value of LTIP cash in £million. LTIP shares = the value of LTIP shares in £million. Managerial shareholdings = the value of managerial shareholdings in £million. DELTA = the sum of the delta value of LTIP shares, options and managerial shareholdings in £million. VEGA= the vega value of stock options in £million. WEALTH is the sum of FAB, LTIP CASH, LTIP Shares and Managerial shareholdings in the period 1993-1997. It also includes Options in the period of 1998-2000. See Section 6.2 for detailed variable definitions. N= number of acquisitions. In parentheses are the t statistics (mean difference), Wilcoxon rank sum test z statistics (median difference) or Chi-Square (χ^2) test Pearson χ^2 statistics (proportional difference). All the tests are based on two-tailed tests. a, b,c indicate the significance at the 1%, 5% and 10% level respectively.

	Panel A: Acquisitions over1993-1997													
	High-tech acquisitions					**Low-tech acquisitions**					**Group difference**			
	Value		**% of wealth**			**Value**		**% of wealth**			**Value**		**% of wealth**	
	Mean	**Median**	**Mean**	**Median**	**N**	**Mean**	**Median**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**	**Mean (t stat)**	**Median (z stat)**
FAB	0.65	0.48	22.56	7.66	124	0.86	0.57	26.58	13.59	161	-0.21 (-2.3)[b]	-0.09 (-2.0)[b]	-4.02 (-1.2)	-5.93 (-1.7)[c]
LTIP Cash	0.001	0.00	0.003	0.00	124	0.01	0.00	0.18	0.00	161	-0.01 (-1.7)[c]	0.00 (-1.3)	-1.08 (-1.8)[c]	0.00 (-1.4)
LTIP Shares	0.02	0.00	0.03	0.00	124	0.03	0.00	0.21	0.00	161	-0.01 (-0.3)	0.00 (-0.5)	-0.18 (-1.4)	0.00 (-0.5)
Managerial shareholdings	11.46	4.72	79.60	92.52	124	13.58	3.39	73.02	86.41	161	-2.12 (-0.6)	1.33 (0.7)	6.58 (1.5)	6.11 (1.8)[c]
WEALTH	12.12	5.12	-	-	124	14.49	5.00	-	-	161	-2.37 (-0.7)	0.12 (0.4)	-	-
DELTA	0.11	0.05	-	-	124	0.14	0.03	-	-	161	-0.02 (-0.6)	0.02 (0.7)	-	-

Table 7-2 (continued)

	Panel B: Acquisition over 1998-2000													
	High-tech acquisitions					**Low-tech acquisitions**					**Group difference**			
	Value		**% of wealth**			**Value**		**% of wealth**			**value**		**% of wealth**	
	Mean	**Median**	**Mean**	**Median**	**N**	**Mean**	**Median**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**	**Mean (t stat)**	**Median (z stat)**
FAB	1.19	0.64	11.87	4.45	165	1.34	0.70	19.12	8.25	128	-0.15 (-1.8)[c]	-0.06 (-1.4)	-7.25 (-3.0)[a]	-3.80 (-3.5)[a]
LTIP Cash	0.04	0.00	0.28	0	165	0.04	0.00	0.22	0.00	128	0.01 (0.1)	0.00 (-1.7)[c]	0.06 (0.2)	0.00 (-1.7)[c]
LTIP Shares	0.26	0.00	1.91	0	165	0.75	0.00	3.21	0.00	128	-0.49 (-1.6)	0.00 (-2.7)[a]	-1.30 (-1.5)	0.00 (-2.7)[a]
Managerial shareholdings	33.80	9.44	74.01	87.06	165	55.04	6.16	68.22	80.68	128	-21.25 (-0.8)	3.28 (2.1)[b]	5.79 (1.7)[c]	6.38 (1.9)[c]
Options	2.90	0.62	11.94	3.84	165	1.31	0.25	9.23	2.69	128	1.59 (2.2)[b]	0.37 (2.9)[a]	2.71 (1.4)	1.15 (1.5)
WEALTH	38.19	13.29	-	-	165	58.48	8.96	-	-	128	-20.29 (-0.7)	4.33 (2.3)[b]	-	-
DELTA	0.37	0.13	-	-	165	0.58	0.08	-	-	128	-0.21 (-0.8)	0.05 (2.3)[b]	-	-
VEGA	0.08	0.02	-	-	165	0.04	0.01	-	-	128	0.04 (2.0)[b]	0.01 (2.2)[b]	-	-

£38 million) but much lower median wealth (about £9 million to £13 million). The median difference is significant at the 5% level.

For the sample of 1993-1997, both the mean and median fixed compensation and annual bonuses (FAB) are significantly (at the 5% level) lower for acquirer directors in the high-tech acquisition group, i.e., £210,000 for the mean difference and £90,000 for the median difference. Although the mean value of the fixed compensation and annual bonuses for acquirer directors in the high-tech acquisition group is nearly doubled in 1998-2000, it is still approximately £150,000 lower than acquirer directors in the low-tech acquisitions and the difference is significant at the 10% level. For both sample periods, fixed compensation and annual bonuses account for a higher proportion of the directors' total wealth in the low-tech acquisitions than they do in the high-tech acquisitions. The median difference, 5.93%, is significant at the 10% level in the 1993-1997 sample period. In the 1998-2000 sample period, both mean difference (7.25%) and median difference (3.8%) are significant at the 1% level. The overall weight of cash compensation in the directors' total wealth however, drops to less than 20% during the period 1998-2000. The drop is as sharp as approximately 10% for acquirer directors in the high-tech acquisitions.

The above finding that cash compensation for board of directors grows over time is consistent with the findings from Main *et al* (1996) and Cosh and Hughes (1997). Based on companies in FTSE 100 list, Main *et al* (1996) find that board of directors' cash compensation rose from £1.27 million in 1981 to £2.32 million in 1989. Cosh and Hughes (1997) report that the cash compensation for boards of directors in the electrical engineering industry rose from £0.25 million to £0.29 million from 1970 to 1989.

For the 1993-1997 sample, the average acquirer directors' LTIP cash award is only £1,000 in the high-tech acquisition group and £10,000 in the low-tech acquisition group but there is no significant difference between them. LTIP cash awards are slightly higher for the 1998-2000 sample, but on average are still less than 0.3% of the total wealth portfolio. From a survey of existing literature it appears that this thesis is the first to analyse and report the level of LTIP cash awards for directors in the UK.

The average value of acquirers' LTIP shares is £20,000 in the high-tech acquisition group for the 1993-1997 sample, £10,000 less than that is in the low-tech acquisition group. In the 1998-2000 sample, the value of LTIP shares increases to £260,000 for acquirer directors in the high-tech acquisition group, but is still £490,000 less than it is for acquirer directors in the low-tech acquisition group. In addition, between the two sample periods the proportion of LTIP shares of directors' total wealth increases substantially from 0.003% to 1.91% for acquirers which conducted high-tech acquisitions, and from 0.21% to 3.21% for acquirers which conducted low-tech acquisitions.

Comparing the weight of LTIPs (LTIP cash and LTIP shares together) with the weight of cash compensation (FAB) in the directors' wealth portfolio shows that LTIPs fall far short of cash compensations. This is consistent with the findings of Conyon and Murphy (2000) (see Section 2.3.1 of Chapter 2) that LTIPs are still a small part of executive compensation in the UK. Conyon *et al* (2000), Conyon and Sadler (2001), Stathopoulos *et al* (2005) also provide similar evidence. For a sample of 200 large UK companies, Conyon *et al* (2000) report that the mean value of LTIP shares granted in the 1997 accounting year is £115,000 and the median is £0. These values fall far short of cash compensation which has a mean value of £451,000 and a median of £390,000.

Using a sample of the 510 largest UK companies for the 1997 accounting year, Conyon and Sadler (2001) report that LTIP shares constitute on average only 0.02% of outstanding shares. Based on 72 UK companies in the retail sector from 1996 to 1999, Stathopoulos *et al* (2005) find that only 13% of directors received LTIP share awards as compared to 75% receiving stock options, and 100% receiving cash compensation.

The average value of managerial shareholdings (Managerial shareholdings) is approximately £11 million and £14 million (median around £4 million) in the high-tech and low-tech acquisition groups over 1993-1997. Although the average value of managerial shareholdings for acquirer directors in the high-tech acquisition group (£33.8 million) is less than that for the directors in the low-tech acquisition group (£55 million) over the period 1998-2000, the median value of £9.4 million for the former is £3.3 million higher (significant at the 5% level) than that for the latter. In addition, acquirer directors in the high-tech acquisition group on average have ordinary shares in their wealth portfolio around 6% (median around 6%) higher than acquirer directors in the low-tech acquisition group. Both mean and median differences are significant at the 10% statistical level. Similar patterns are also evident in the 1993-1997 sample and the median difference is significant at the 10% level.

The above statistics show that managerial shareholding is the largest component of directors' total wealth, consistent with the literature evidence discussed in Section 2.3.1 of Chapter 2. The proportion of managerial shareholdings in directors' total wealth decreases from around 86% to around 81% (median) between the two sample periods for low-tech acquisitions while it decreases from 93% to 87% for high-tech acquisitions.

Earlier studies such as Sudarsanam *et al* (1996) and Kohers and Kohers (2001) also report the statistics for managerial shareholdings as a percentage of the company's outstanding share capital. To provide results comparable with those studies, this thesis also reports this statistics (MANSHR) defined as the % of ordinary shares, beneficial and non-beneficial, held by board of directors, in the accounting year prior to an acquisition announcement. The statistics are reported in Table 7A-1 in the Appendix to this chapter. In both sample periods, managerial shareholdings held by acquirer directors in the high-tech acquisition group is higher than those held by acquirer directors in the low-tech acquisition group both in terms of the mean and median value, but only the median difference in the 1993-1997 sample is statistically significant (at the 5% level). Kohers and Kohers (2001) report a mean shareholding of 15% (median 9%) for acquirer directors for a sample of 304 US high-tech acquisitions from 1984 to 1995. This level of managerial shareholding is approximately the same as that found in this study (see Table 7A-1 in the Appendix to this chapter). Sudarsanam *et al* (1996) report a mean holding of 10% by acquirer directors for a sample of 429 acquisitions from 1980 to 1990, about 5% lower than those reported in this study.

Data for directors' stock option holdings (Options) are only available for the 1998-2000 sample. As shown in Table 7-2, the average value of stock options is £2.9 million (median £0.6 million) for acquirer directors who conducted high-tech acquisitions as compared to £1.3 million (median £0.3 million) for acquirer directors who undertook low-tech acquisitions. Both mean and median differences are significant at the 5% and 1% levels respectively.

To gain further insight into the difference between the values of stock options of the high-tech and the low-tech acquisition groups, I examine the parameters that determine the value of stock options[137]. Stock price and stock option exercise price are two key parameters. According to the Black-Scholes (1973) option pricing model, the higher the stock price (P) and the lower the exercise price (X), then the greater the value of the stock options (C). The ratio of stock price to exercise price of the stock option (P/X) is called the 'moneyness' of a stock option. When P is higher than X, the stock option is 'in-the-money'; when P is the same as X, the option is 'at-the-money'; when P is lower than X, the option is 'out-of-the-money' (see Section 2.3.3.1 of Chapter 2). Deeply out-of-the-money options are argued to induce managers to engage in excessive risk taking (see Section 2.3.2.4 of Chapter 2).

The moneyness of stock options held by acquirers' directors prior to acquisition announcement is reported in Table 7-3. The average stock option moneyness of high-tech acquisitions is 13.7 and the median is 2.24. In comparison, the mean and median values for acquirers in the low-tech acquisition group are much lower, 2.96 and 1.61 respectively. The maximum moneyness in the high-tech acquisitions group is 507.5 while only 12 in the low-tech acquisition group. Those statistics show that acquirers in the high-tech acquisition group have far deeper in-the-money stock options than acquirers in the low-tech acquisitions. This contradicts the argument that deep out-of-the-money stock options encourage managerial risk taking (see Section 2.3.2.4 of Chapter 2).

Why don't those directors cash in those deeply in-the-money options? Malmendier and Tate (2004) and Malmendier and Tate (2005b) offer a possible explanation. They attribute this puzzling phenomenon to managerial overconfidence.

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[137] See Equation 6-2 in Chapter 6 for the Black-Scholes (1973) option pricing model which is used to calculate the value of stock options.

Overconfident managers believe in their ability to improve firm performance and are persistently bullish about their companies' future prospects. They engage in risky acquisitions and believe that they can further push up the stock price so that they can gain even more from their option holdings. These directors, however, never expected that the stock market would crash in 2001 and their options became worthless within days.

Table 7-3: Descriptive statistics for moneyness and time to maturity of stock options

The table lists the descriptive statistics for the moneyness and the time to maturity of stock options held by acquirer board of directors prior to acquisition announcement for the sample period of 1998-2000. Moneyness is measured as the ratio of the stock price (P) at the end of month –2 prior to acquisition announcement month, 0 over the exercise price of a stock option (X). Time to maturity (T) is measured as the time difference in years between the expiry date of a stock option and the end of the month –2 prior to acquisition announcement month, 0. N = number of acquisitions.

	Panel A: Moneyness		*Panel B: Time to Maturity*	
	High-tech acquisitions	**Low-tech acquisitions**	**High-tech acquisitions**	**Low-tech acquisitions**
N	165	128	165	128
Mean	13.70	2.96	5.52	5.21
Median	2.24	1.61	5.48	5.27
Minimum	0.08	0.11	0.06	0.13
Maximum	507.50	54.91	12.00	9.93
Standard Deviation	118.59	5.94	2.60	2.48

Table 7-3 also reports the time to maturity of stock options. Time to maturity (T) is the time remaining in years from the end of month –2 prior to acquisition announcement, 0, to the expiry date of a stock option. The longer the T, the more valuable the stock option (see Equation 6-2 in Chapter 6). When the time to maturity is long, directors can still have the incentive to engage in risky high-tech acquisitions and benefit from the possible rising of the stock price as a result of the acquisition. Directors are less likely to have such an incentive when the time to maturity is short because high-tech acquisitions have a long payback period (see Section 5.3 of Chapter 5 for a discussion of the risk profile of high-tech acquisitions). Table 7-3, however, shows that time to maturity is similar between the high-tech acquisition group and the low-tech acquisition group.

Table 7-2 shows that in the low-tech acquisition group, the mean option holdings as a % of the total wealth of acquirer directors ranks the third highest after Managerial shareholdings and cash pay (FAB). The ranking is the same in terms of median values. Although options rank only after cash pay, the differences in terms of percentage of total wealth is large. The mean value of options holdings is 9% of the total wealth, but 19% for cash pay. The difference is even larger when considering the median percentages, 2.69% versus 8.25%. The differences however, are much smaller in the high-tech acquisition group. Option holdings are on average 11.94% of the total wealth of acquirer directors, even higher than cash pay (11.87%). Stock options rank the second highest after managerial shareholdings in proportions of managerial total wealth. In terms of median values, option holdings still fall behind cash pay, but the difference is small (0.61%).

Table 7-1 has shown that in the high-tech acquisition group, 72% of the acquirers are in the high-tech industries while in the low-tech industries only 14% of the acquirers are in the high-tech industries. The difference in the option holdings between acquirer directors in these two acquisition groups may reflect the difference in stock options held by managers of high-tech firms and managers of low-tech firms. If so firms in high-tech industries have substantially higher option rewards than firms in low-tech industries. This is consistent with the findings of a group of studies which examine the remuneration practice between new economy firms (i.e,. internet, e-commerce or dot.com firms) and old economy firms (i.e., low-tech firms). They generally find that new economy firms (i.e. high-tech firms) reward managers with much higher levels of stock options than old economy firms. Ittner *et al* (2003) and Murphy (2003) draw their conclusions based on US companies. For a sample of 217 firms over the accounting year 1998 and 1999, Ittner *et al* (2003) find that the mean (median) CEO in a new economy firm receives 78.2% (86.9%) of compensation from equity grants (stock options and restricted stocks), versus 26.9% (19.3%) in an old economy firm. Murphy (2003) concludes based on S&P firms that for every year from 1992 to 2000, new economy firms are more likely than old economy firms to offer stock options or restricted stocks to their top-five executives. Stathopoulos *et al* (2005) report the same evidence based on UK companies. For a sample of 552 directors of 72 UK listed retail companies in the financial year of 1999, they find that the average value of the options received by each new economy CEO is double that of their old economy counterparts.

Conyon and Murphy (2000) report that options rank third by value after managerial shareholdings and cash pay in the managers wealth portfolios for the CEOs of 510 UK large companies for the 1997 accounting year. They therefore conclude that stock options and even equity-based compensation as a whole is still a small part of the UK managerial compensation (see Section 2.3.1 of Chapter 2). My results discussed above with regard to stock options show that their conclusion holds for low-tech companies but may not apply to high-tech companies. In fact, equity-based compensation including LTIP shares and stock options is on average 2% higher than cash pay (FAB) during the telecom and internet boom period of late 1990s. But the median level is slightly lower (0.6%) for equity-based compensation. It is true that, unlike in the US (see Section 2.3.1), in the UK equity-based compensation does not dominate cash pay and is not the major component of executive compensation.

Having covered acquirer directors' overall wealth level, the discussion will now turn to the sensitivity of equity-based wealth to company stock price performance, i.e. delta and vega. In 1993-1997, the average equity delta (DELTA) (including deltas of LTIP shares, and managerial shareholdings) is £0.11million (median £50,000) for acquirer directors in the high-tech acquisition group. This means that a 1% change in the stock price will on average cause a fluctuation of directors' wealth of £0.11million. The delta is £0.14 million (median £30,000) for acquirer directors in the low-tech acquisition group over the same period. The impact of the change of stock price on directors' wealth is more substantial in the 1998-2000 sample, where the average delta value reaches £0.37 million for acquirer directors in the high-tech acquisition group and £0.58 million for acquirer directors in the low-tech acquisition group. The median value for the former (£0.13 million) is £50,000 higher than it is for the latter (significant at the 5% level).

A breakdown of equity delta (DELTA) into deltas for LTIP shares (LTIP delta), stock options (OPTION DELTA), and for managerial shareholdings (SHARE DELTA) is reported in Table 7A-1 in the Appendix to this chapter. Share delta dominates equity delta for both sample periods, indicating that the pay-performance incentive from directors' equity- based wealth is mainly influenced by managerial shareholdings. Both LTIP delta and Share delta are higher in the 1998-2000 sample period than in the 1993-1997 sample period. This is consistent with the previous discussion of the values of

LTIP shares and managerial shareholdings, which show that both types of equity grow over time. This in turn increases the pay-performance link between managers' wealth and firm stock performance and thereby increases LTIP delta and Share delta.

In 1998-2000, stock option delta (OPTION DELTA) on average is about £15,000 (significant at the 10% level) higher in the high-tech acquisition group than in the low-tech acquisition group. The median difference is £4,000 (significant at the 5% level). This indicates that for 1% increase (decrease) in a company' stock price, acquirer directors in the high-tech acquisition group gain (lose) on average £15,000 more than acquirer directors in the low-tech acquisition group. The wealth of the former directors is at more risk than that of the latter directors. This thesis is one of the few studies that adopt the approach suggested by Core and Guay (1999) to calculate equity delta. Another is Stathopoulos *et al* (2005). However their statistics are not comparable to those presented in this thesis because they report the weighted sum of the delta for a stock option in each tranche held by directors, whereas this study reports the delta for the whole stock option holdings.

Panel B of Table 7-2 reports the value of option vega (VEGA). The average option vega (VEGA) is £80,000 for acquirer directors in the high-tech acquisition group, indicating that a 1% increase in stock price volatility can increase directors' wealth by £80,000. The vega value for acquirer directors in the low-tech acquisition group is only a half of that for acquirer directors in the high-tech acquisition group. The median vega value for acquirers in the high-tech acquisition group is £10,000 higher than that for acquirers in the low-tech acquisition group. Both differences are significant at the 5% level. These results indicate that the wealth of acquirer directors in the high-tech acquisition group is more sensitive to changes in firm risk, i.e., stock return volatility, than that of their counterparts in the low-tech acquisition group. The former directors thus should have stronger incentive to increase firm risk than the latter directors. This thesis is the first study to report option vega for UK companies.

Overall, the findings above show that the wealth of acquirer directors who conducted high-tech acquisitions are more closely linked to own firm stock price performance and stock return volatilities than that of acquirer directors who initiated low-tech acquisitions. In addition, despite the growing importance of equity-based compensation, equity-based compensation is still a relatively small part of UK directors' compensation packages.

7.3.2 Behavioural biases

The descriptive statistics on hubris are reported in Table 7-4. Acquirers which bought high-tech targets have significantly better stock performance prior to acquisitions than acquirers of low-tech targets in the 1998-2000 sample (in Panel B). The total one-year stock returns prior to acquisition announcement (PAST) for the former is 138% (median 44%) versus 33% (median 17%) for the latter. Both the mean and median differences are significant at the 1% level. The ratios however are not significantly different from each other in the 1993-1997 sample. Comparing the two sample periods, the mean PAST ratio increases substantially from around 27% to 138%, and median from 15% to 44% in the high-tech acquisition group. The increases in the ratios over time are not as large as in the low-tech acquisition group. As reported in Table 7-1, over 70% of the acquirers in the high-tech acquisition group are high-tech acquirers. The superior stock price performance of acquirers in the high-tech acquisition group may not be due to the superior value created by those companies, but

Table 7-4: Summary descriptive statistics for behavioural bias variables

This table lists the descriptive statistics for variables that induce managerial behavioural biases. Panel A reports the statistics for the acquisitions over the period of 1993-1997 and Panel B reports the statistics for the acquisitions over the period of 1998-2000. PAST = % of acquirer stock returns of month –2 versus month –12 (month 0 is the announcement month). BEME = % of acquirer book value of equity relative to acquirer market value of equity. MEDIA = weighted sum of the scores for newspaper articles that comment on the performance of acquirer directors from month –37 to month –2 prior to announcement month,0. See Section 6.2 for the detailed variable definitions. N = number of acquisitions. In parentheses are t statistics (mean difference), Wilcoxon rank sum test z statistic (median difference). All the tests are based on two-tailed tests. a, b and c indicate the significance at the 1%, 5% and 10% level respectively.

Panel A: Acquisitions over 1993-1997

	High-tech acquisitions			Low-tech acquisitions			Group difference	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t-stat)**	**Median (z-stat)**
PAST	27.48	15.00	124	22.54	15.09	161	4.94 (0.8)	-0.09 (-0.5)
BEME	29.77	17.44	124	43.81	36.49	161	-14.04 (-2.8)[a]	-19.05(-5.1)[a]
MEDIA	0.91	1.00	124	0.78	1.00	161	0.13 (1.0)	0.00(0.4)

Panel B: Acquisitions over 1998-2000

	High-tech sample			Low-tech sample			Group difference	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t-stat)**	**Median (z-stat)**
PAST	137.52	44.00	165	32.65	17.46	128	104.90 (4.0)[a]	26.54 (4.1)[a]
BEME	21.22	10.95	165	45.76	30.81	128	-24.54 (-3.6)[a]	-19.86(-6.2)[a]
MEDIA	0.93	1.00	165	0.70	0.25	128	0.23 (1.9)[b]	0.75(1.7)[c]

more to do with, as Ittner *et al* (2003), Murphy (2003) and Stathopoulos *et al* (2005) describe, the overheated telecom/internet stocks in the late 1990s. The PAST ratios reported in this study are higher than those reported by Hayward and Hambrick (1997), i.e., an average of 28.7%. The difference reflects the stock performance in the bull market of late 1990s which is covered by this study while their sample period covers 1989 and 1992.

In the 1993-1997 sample, the average book-to-market ratio (BEME) prior to acquisition announcement is about 29.8% for acquirers in the high-tech acquisition group, and about 43.8% for acquirers in the low-tech acquisition group. The difference, -14%, is significant at the 1% level. The median ratio is also significantly lower for the former than for the latter. The same pattern can be observed in the 1998-2000 sample. Those results indicate that acquirers of high-tech targets had much higher glamour ratings prior to acquisition announcements than acquirers of low-tech targets. Comparing the two sample periods, the mean BEME ratios drop substantially from around 30% to 21% and medians drop from 17% to 11% for acquirers in the high-tech acquisition group. Such a phenomenon does not happen to acquirers in the low-tech acquisition group. The mean ratios for those acquirers increase even though the median decreases. This result shows that the glamour rating of acquirers in high-tech acquisition group was greatly enhanced by the bull stock market of the late 1990s.

The BEME ratios reported above are much lower than those reported by Kohers and Kohers (2001), who find an average BEME of 64% and a median of 54%. This may be because Kohers and Kohers' sample does not include the peak of the stock market in the late 1990s when the stock prices were pushed substantially higher than their real asset value, whereas this thesis does.

Table 7-4 reports the weighted sum of the media scores (MEDIA), i.e., 3 points, 2 points, 1 point, 0 point, -1 point and –2 points, given to each media article that comments on directors' profile or performance over the three-year period prior to acquisition announcement. How a score is awarded to an article is discussed in Section 6.2.1.3 of Chapter 6 and how the weighted sum of the scores is calculated is shown in Equation 6-9 in Chapter 6. If a score is 0, it means that directors of an acquiring company do not receive any comments (defined by this thesis) from the media during the period examined. If the weighted sum of scores is less than 1 but not equal to zero, it means that there are more negative media comments than positive comments. If it is equal to 1, it means that there are equally amount of positive and negative comments, and if greater than 1, it means that there are more positive comments than negative comments.

The average weighted sum of scores as shown in Table 7-4 for acquirers in the high-tech acquisition group remain the same between two periods (all about 0.9) but the medians substantially decline (1 versus 0.25) for acquirers in the low-tech acquisition group. In 1998-2000, the mean score for acquirers in the high-tech acquisition group is 0.93 and for acquirers in the low-tech acquisition group is 0.70. The median values for both types of acquirers are 1.00 and 0.25 respectively. The differences in mean and median values for both types of acquirers are significant at the 5% and 10% level respectively. The above results imply that the high-tech boom in the late 1990s resulted in top executives of high-tech firms[138] enjoying a warmer and more flattering media limelight than directors in low-tech companies.

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[138] As shown in Table 7-1, over 70% of the acquirers in the high-tech acquisition group are high-tech companies.

To gain more insights in to the media scores, I report the data for the scores given to each article in Table 7A-2. It shows the number of articles for each score as a percentage of the total number of articles on the directors of acquirers 3 years prior to the acquisition announcement. Only a few articles make mostly negative comments about acquirers, while most of the articles are either favourable to directors or contain a only small amount of negative comments. During the period of 1993-1997, both acquirers in the high-tech acquisition group and in the low-tech acquisition group enjoy a similar amount of media attention, i.e., both have similar amount of newspaper articles making comments on them as shown in 'Total coded articles'. By contrast, in the 1998-2000 sample period, the number of newspaper articles for acquirers in the high-tech acquisition group, 581 articles, is more than double that of the articles on acquirers in the low-tech acquisition group. This again shows that the media was favourable toward top-executives in high-tech firms during the high-tech boom period of the late 1990s.

Hayward and Hambrick (1997) report a mean score of media praise for acquirers of 0.17 which is lower than that reported in this thesis. This can be because *inter alia*, that their sample period does not include the bull stock market of late 1990s. It may also because of the difference in judgement over rating an article. As pointed out in Section 6.2.1.3 of Chapter 6, the coding of articles is highly subjective to the reader's judgement. It is possible that I offer more positive scores to those articles than Hayward and Hambrick. Section 9.3 of Chapter 9 suggests ways to reduce the subjectivity in the coding process.

Collectively, the data show that acquirers that conducted high-tech acquisitions have significantly better past stock performance, higher glamour status, and receive more positive media comments prior to acquisition announcements than acquirers that conducted low-tech acquisitions. The difference widens as the high-tech boom progressed during the 1990's and become strongly significant during 1998-2000.

7.3.3 Monitoring mechanisms

Descriptive statistics for monitoring mechanisms are reported in Table 7-5. In the 1993-1997 sample, the average sum of external blockholdings (LARSHR) is around 28% in the high-tech acquisition group and about 32% in the low-tech acquisition group. The medians are 24% and 30% respectively. The differences in mean and median values are significant at the 10% level. In the 1998-2000 sample, the mean value is significantly lower but the median is about 0.28% higher in the high-tech acquisition group than that in the low-tech acquisition group. The sum of institutional shareholdings (INSTSHR) is lower in the high-tech acquisition group than that in the low-tech acquisition group both in terms of mean and median in the two sample periods. However, the differences are not statistically significant. Overall, these results indicate that there is more external shareholder control in acquirers that conducted low-tech acquisitions than acquirers that initiated high-tech acquisitions.

Sudarsanam *et al* (1996) report an average external blockholdings of 11% over 1980-1990. Frank *et al* 2001 document a holding of around 15% between 1990 and 1993. Weir *et al* (2002) find external blockholdings of around 11% from 1994 to 1996. Weir and Laing (2000) report a ratio of around 22% 1992 and 1995. This study reports an average ratio around 30%. It appears that UK corporate governance is

Table 7-5: Summary descriptive statistics for monitoring mechanisms

This table lists the descriptive statistics for the monitoring mechanisms of acquirers prior to acquisition announcements. Panel A reports the statistics for acquisitions in 1993-1997 and Panel B is for acquisitions in 1998-2000. LARSHR = % of external blockholdings in acquirers. INSTSHR = % of institutional blockholdings in acquirers. NEXE = % of non-executive directors on acquirer board. NONDUAL = 1 if CEO and COB are different people and 0 otherwise. REM = 1 if acquirer board has a remuneration committee and 0 otherwise. N= number of acquisitions. In parentheses are the t statistics (mean difference), Wilcoxon rank sum test z statistic (median difference) or Chi-Square (χ^2) test Pearson χ^2 statistics (proportional difference). All the tests are based on two-tailed tests. a, b and c indicate the significance at the 1%, 5% and 10% level respectively.

Panel A: Acquisitions over 1993-1997

	High-tech acquisitions			Low-tech acquisitions			Group difference	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**
LARSHR	27.70	24.32	124	31.82	30.38	161	-4.12(-1.8) [c]	-6.06 (-1.8) [c]
INSTSHR	24.14	21.81	124	26.36	24.11	161	-1.79(-1.1)	-.2.30(-1.0)
NEXE	39.70	40.00	124	42.83	42.86	161	-3.13 (-1.7) [c]	-2.86(-1.5)
	N	**Sample size**	**% of acquisitions**	**N**	**Sample size**	**% of acquisitions**	**Proportion (χ^2 stat)**	
NONDUAL	90	124	72.58	120	161	74.53	-1.95(0.1)	
REM	108	124	87.10	140	161	86.96	0.14(0.0)	

Panel B: Acquisitions over 1998-2000

	High-tech acquisitions			Low-tech acquisitions			Group difference	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**
LARSHR	26.00	27.19	165	30.63	26.91	128	-4.63(-2.2) [b]	0.28 (1.8) [c]
INSTSHR	23.04	21.17	165	25.30	21.61	128	-1.71(1.12)	-0.44(0.87)
NEXE	44.34	42.86	165	44.55	42.86	128	-0.21 (-0.1)	0.00(0.0)
	N	**No. of acquisition**	**% of acquisitions**	**N**	**No. of acquisition**	**% of acquisitions**	**Proportion (χ^2 stat)**	
NONDUAL	127	165	76.97	108	128	84.38	-7.41(2.5)	
REM	153	165	92.73	123	128	96.09	3.33 (1.5)	

getting stronger over time with more external blockholder control in companies[139].

During 1998-2000, acquirers in both high-tech and low-tech acquisition groups have the same ratio (44%) for the percentage of non-executive directors on the board (NEXE). The ratio is about 3% lower for acquirers in the high-tech acquisition group than acquirers in the low-tech acquisition group during 1993-1997, indicating weaker corporate control of directors in the high-tech acquisition group. Weir *et al* (2002) report a ratio of 47% for all UK listed non-financial companies from 1994-1996. Weir (1997) finds even higher ratios (around 60%) in his sample of 94 UK takeovers during 1990-1993. Dahya *et al* (2003) report board compositions of over 50% non-executive directors for 700 companies listed in London Stock Exchange from 1993 to 1999. All of these results show that UK boards generally adhere to the Cadbury (1992) recommendations that non-executive directors should dominate the board.

For both sample periods, over 70% of the acquirers have a separate CEO and chairman (NONDUAL). This is consistent with the findings of Weir and Laing (2000) who report 71% in 1992 and 85 % in 1995, and by Weir *et al* (2002) who report 84% over the period 1994-1996. Those results indicate good compliance with the recommendation of the Cadbury Report (1992) that the roles of CEO and COB should be separated.

For both high-tech and low-tech acquisition groups in the 1993-1997 sample period, about 87% of the acquirers have a remuneration committee. The ratio

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[139] There may also exist some other reasons why the external blockholdings reported in this study are higher than those in the others. For instance, firm examined in this study may be smaller than those examined by the other studies. Smaller firms are more likely to have concentration of ownership than larger firms.

increases to above 92% in the 1998-2000 sample period. There appears to be no differences in the ratios between acquirers in the high-tech and low-tech acquisition groups. Weir and Laing (2000) report similarly high ratios. Conyon *et al* (1995) summarise UK compensation papers and report that the proportion of listed UK companies that have remuneration committees reached 94% by 1993. All of these results show that UK boards have a high level of compliance with the recommendations made in the Cadbury Report (1992) that company boards should establish a remuneration committee to determine the compensation level of directors.

Taken together, the above results show that there appears to be less external blockholder or institutional blockholder control associated with acquirer boards in the high-tech acquisition group. Little difference is found between the two acquirer groups with regard to board independence, CEO-COB nonduality, and the presence of a remuneration committee

7.3.4 Other incentives

Section 6.2.1.4 of Chapter 6 describes that financial leverage, acquirer size and the relative size of acquirer to target also influence managers' decision of acquisition risk. There is not much difference in the leverage ratio (Table 7-6) between acquirers in high-tech acquisition and low-tech acquisition groups over the two sample periods. The means and the medians are all between 55%-58%. Acquirer size (MV) and the relative size of acquirer to target (RELSIZ) have been discussed in Section 7.2.1 which shows no statistically significant differences between the high-tech acquisition group and low-tech acquisition group in both sample periods.

Table 7-6: Summary descriptive statistics for leverage ratio

This table lists the descriptive statistics for acquire leverage ratio prior to acquisitions. Panel A shows the descriptive statistics for acquisitions over 1993-1997 and panel B reports the statistics for acquisitions over 1998-2000. LEV = % of an acquirer's total liability over total assets in the accounting year prior to the acquisition announcement. N= number of acquisitions. In parentheses are the t statistics (mean difference) or Wilcoxon rank sum test z statistic (median difference). All the tests are based on two-tailed tests. a, b and c indicate the significance at the 1%, 5% and 10% level respectively.

	Panel A: Acquisitions over 1993-1997							
	High-tech acquisitions			**Low-tech acquisitions**			**Group difference**	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**
LEV	57.05	57.87	124	55.46	55.11	161	1.59 (0.7)	2.76(1.00)

	Panel B: Acquisitions over 1998-2000							
	High-tech acquisitions			**Low-tech acquisitions**			**Group difference**	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**
LEV	58.34	57.77	165	57.69	56.83	128	0.65 (0.2)	0.94(0.6)

7.3.5 Summary

Section 7.3 lists the descriptive statistics for risk incentives including wealth incentive, managerial behavioural biases, corporate monitors and other incentives for acquirers in the high-tech acquisition group and the low-tech acquisition group over the two sample periods 1993-1997 and 1998-2000. In summary, Section 7.3 reports that fixed compensation and annual bonuses are significantly higher in the low-tech acquisition group for both sample periods. While there is little difference in equity-based wealth or overall wealth between the two acquirer groups in the 1993-1997 sample period, both are significantly larger for acquirers of high-tech targets in the 1998-2000 sample period in terms of the median values. The growing importance of stock options appears more in high-tech companies than in low-tech companies. Equity-based compensation (excluding managerial shareholdings) still ranks behind cash compensation in executive compensation in the UK.

Factors that encourage managerial overconfidence/over-optimism/hubris such as good past stock performance, glamour status, and media praise are significantly more apparent for acquirers of high-tech targets than for acquirers of low-tech targets, particularly in 1998-2000.

In both sample periods, acquirers in the high-tech acquisition group are subject to less external blockholder or institutional blockholder control than acquirers in the low-tech acquisition group. Acquisition groups for both sample periods show few differences in corporate monitoring from non-executive directors, the separate roles of CEO and COB, as well as the presence of a remuneration committee.

In addition, no significant financial leverage difference, acquirer size difference, or relative size acquirer to target difference can be seen between acquirers that conducted high-tech acquisitions and acquirers that initiated low-tech acquisitions.

7.4 Determinants of acquisition risk

This section reports results derived from the empirical risk model (Model 6-1) which aims to identify key factors in managers' selection of risky acquisitions. Table 7-7 and Table 7-8 are for the sample period 1993-1997, and Table 7-9 and Table 7-10 are for the sample period 1998-2000. Table 7-7 and Table 7-9 are logistic regression models where the dependent variable is proxied by target high-tech industry status. The sample is divided into 2 risk groups: high-tech acquisitions and low-tech acquisitions. The former acquisitions are considered riskier than the latter acquisitions. A dummy variable separating the two groups is coded as 1 if a target is in a high-tech industry and 0 if it is in a low-tech industry. Both coefficients and odds ratios are reported in the tables (see Section 6.5.1.3 of Chapter 6 for a discussion on logistic regressions). Table 7-8 and Table 7-10 are OLS regression models

Table 7-7: Logistic regressions of target high-tech status over 1993-1997

Dependent variable is 0 if a target is in a low-tech industry and 1 if in a high-tech industry. FAB = fixed compensation and annual bonus in £million. LTIPCASH = LTIP cash awards in £million. DELTA=the sum of the delta values of LTIP shares, options and ordinary shares in £million. $DELTA^2$ = the squared term of DELTA. DELTA*WEALTH = interaction of DELTA and WEALTH. WEALTH is measured as the sum of fixed compensation, annual bonuses, LTIP cash, LTIP shares, and managerial shareholdings in £million. PAST = % of acquirer stock returns of month –2 versus month –12 (month 0 is acquisition announcement month). BEME = % of acquirer book value of equity to acquirer market value of equity. MEDIA= the weighted sum of the scores for newspaper articles that comment on acquirer directors over 3 years prior to acquisition announcement. LARSHR = % of large external shareholdings. NEXE = % of non-executive directors on an acquirer board. NONDUAL = 1 if acquirer CEO and COB are different people and 0 otherwise. REM = 1 if an acquirer has a remuneration committee and 0 otherwise. LEV = % of acquirer's total liability over total assets. MV = natural logarithm of acquirer market value of equity. RELSIZ = natural logarithm of the ratio of the size of an acquirer to the size of its target. N = Number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. Odds ratio is the probability of a high-tech acquisition happening to it not happening. In parentheses are the Wald statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	1.73(5.41)[b]		1.57(4.29)[b]		1.57(4.29)[b]	
FAB	-0.35(1.14)	0.70	-0.35(1.12)	0.70	-0.35(1.10)	0.71
LTIP CASH	-3.16(0.21)	0.04	-3.66(0.28)	0.03	-3.63(0.27)	0.03
DELTA	-0.83(1.11)	0.44	0.98(0.25)	2.66	0.96(0.23)	2.60
$DELTA^2$			-2.28(0.97)	0.10		
DELTA*WEALTH					-0.02(0.94)	0.98
PAST	-0.00(0.01)	1.00	-0.00(0.02)	1.00	-0.00(0.02)	1.00
BEME	-0.02(14.27)[a]	0.98	-0.02(13.30)[a]	0.98	-0.02(13.31)[a]	0.98
MEDIA	0.13(0.97)	1.14	0.13(1.01)	1.14	0.13(1.02)	1.14
LARSHR	-0.01(3.07)[c]	0.99	-0.01(2.63)	0.99	-0.01(2.64)	0.99
NEXE	-0.01(1.49)	0.99	-0.01(1.26)	0.99	-0.01(1.26)	0.99
NONDUAL	0.11(0.48)	1.23	0.12(0.57)	1.26	0.11(0.57)	1.26
REM	0.19(0.79)	1.45	0.19(0.83)	1.47	0.19(0.83)	1.47
LEV	0.00(0.20)	1.00	0.00(0.20)	1.00	0.00(0.20)	1.00
MV	-0.110.63)	0.90	-0.11(0.68)	0.89	-0.11(0.68)	0.89
RELSIZ	-0.02(0.05)	0.98	-0.02(0.07)	0.98	-0.02(0.07)	0.98
N	285		285		285	
Log likelihood	33.37[a]		34.98[a]		34.94[a]	
Pseudo-R^2	11.05%		11.55%		11.54%	

Table 7-8: OLS regressions of target industrial R&D intensity over 1993-1997

The dependent variable target industry R&D intensity is measured by target industry R&D expenditure/sales in the accounting year prior to acquisition announcement. FAB = fixed compensation and annual bonus in £million. LTIPCASH = LTIP cash award in £million. DELTA= the sum of the delta values of LTIP shares, options and ordinary shares in £million. $DELTA^2$ = the squared term of DELTA. DELTA*WEALTH = interaction of DELTA and WEALTH. WEALTH is measured as the sum of fixed compensation, annual bonuses, LTIP cash, LTIP shares, and managerial shareholdings in £million. PAST = % of acquirer stock returns of month –2 versus month –12 (month 0 is announcement month). BEME = % of acquirer book value of equity to acquirer market value of equity. MEDIA= the weighted sum of the scores for newspaper articles that comment on acquirer directors over 3 years prior to acquisition announcement. BEME = % of acquirer book value of equity to acquirer market value of equity. LARSHR = % of large external shareholdings. NEXE = % of non-executive directors on acquirer board. NONDUAL = 1 if acquirer CEO and COB are different people and 0 otherwise. REM = 1 if an acquirer board has a remuneration committee and 0 otherwise. LEV = % of acquirer's total liability over total assets. MV = natural logarithm of acquirer market value of equity. RELSIZ = natural logarithm of the ratio of the size of an acquirer to the size of its target. N = number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are the t statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	4.16(4.27)[a]	3.63(3.70)[a]	3.63(3.69)[a]
FAB	-0.34 (-0.86)	-0.28(-0.71)	-0.27(-0.69)
LTIP CASH	-3.50(-0.54)	-4.97(-0.78)	-4.93(-0.77)
DELTA	-0.24(-0.24)	6.17(2.55)[a]	6.19(2.54)[a]
$DELTA^2$		-7.17(-2.67)[a]	
DELTA*WEALTH			-0.07(-2.66)[a]
PAST	-0.00(-0.59)	-0.00(-0.81)	-0.00(-0.81)
BEME	-0.01(-2.49)[a]	-0.01(-2.19)[b]	-0.01(-2.19)[b]
MEDIA	-0.19(-1.14)	-0.18(-1.10)	-0.18(-1.10)
LARSHR	-0.01(-1.03)	-0.01(-0.73)	-0.01(-0.73)
NEXE	-0.02(-1.34)	-0.01(-1.11)	-0.01(-1.11)
NONDUAL	0.53(1.35)	0.57(1.50)	0.57(1.50)
REM	0.15(0.29)	0.17(0.34)	0.17(0.34)
LEV	0.02(1.32)	0.01(1.28)	0.01(1.29)
MV	0.05(0.31)	0.03(0.20)	0.03(0.19)
RELSIZ	-0.13(-1.11)	-0.14(-1.23)	-0.14(-1.23)
N	285	285	285
F statistics	1.44	1.88[b]	1.87[b]
Adjusted R^2	1.98%	4.15%	4.12%

Table 7-9: Logistic regressions of target high-tech status over 1998-2000

Dependent variable is 0 if a target is in a low-tech industry and 1 if in a high-tech industry. FAB = fixed compensation and annual bonus in £million. LTIPCASH = LTIP cash awards in £million. DELTA=the sum of the delta values of LTIP shares, options and ordinary shares in £million. $DELTA^2$ = the squared term of DELTA. DELTA*WEALTH = interaction of DELTA and WEALTH. WEALTH is measured as the sum of fixed compensation, annual bonuses, LTIP cash, LTIP shares, stock options and managerial shareholdings in £million. VEGA = stock option vega in £million. VEGA*WEALTH = interaction of VEGA and WEALTH. PAST = % of acquirer stock returns of month –2 versus month –12 (month 0 is acquisition announcement month). BEME = % of acquirer book value of equity to acquirer market value of equity. MEDIA= the weighted sum of the scores for newspaper articles that comment on acquirer directors over 3 years prior to acquisition announcement. LARSHR = % of large external shareholdings. NEXE = % of non-executive directors on an acquirer board. NONDUAL = 1 if acquirer CEO and COB are different people and 0 otherwise. REM = 1 if an acquirer has a remuneration committee and 0 otherwise. LEV = % of acquirer's total liability over total assets. MV = natural logarithm of acquirer market value of equity. RELSIZ = natural logarithm of the ratio of the size of an acquirer to the size of its target. N = Number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. Odds ratio is the probability of a high-tech acquisition happening to it not happening. In parentheses are the Wald statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	0.52(0.48)		0.47(0.39)		0.40(0.28)	
FAB	-0.27(3.93) [b]	0.77	-0.26(3.91) [b]	0.77	-0.35(4.54) [b]	0.70
LTIP CASH	-0.44(0.20)	0.64	-0.31(0.10)	0.73	-0.07(0.01)	0.93
DELTA	-0.14(0.62)	0.87	0.49(0.89)	1.64	0.11(0.04)	1.12
$DELTA^2$			-0.12(1.58)	0.89		
DELTA*WEALTH					-0.00(2.01)	1.00
VEGA	1.09(0.43)	2.98	1.75(0.19)	2.10	-1.67(0.59)	0.19
VEGA*WEALTH					0.05(2.62)	1.05
PAST	0.004(6.94) [a]	1.00	0.004(6.62) [a]	1.00	0.004(6.48) [a]	1.00
BEME	-0.01(6.72) [a]	0.99	-0.01(6.24) [a]	0.99	-0.01(5.71) [a]	0.99
MEDIA	0.27(3.86) [b]	1.30	0.26(3.55) [c]	1.30	0.28(3.91) [b]	1.32
LARSHR	-0.00(0.13)	0.99	-0.00(0.0)	1.00	-0.00(0.00)	1.00
NEXE	-0.00(0.01)	0.99	-0.00(0.00)	1.00	-0.00(0.00)	1.00
NONDUAL	-0.16(0.81)	0.73	-0.16(0.80)	0.73	-0.16(0.84)	0.72
REM	-0.46(1.95)	0.40	-0.50(2.26)	0.37	-0.51(2.35) [c]	0.36
LEV	-0.00(0.10)	1.00	-0.00(0.17)	1.00	-0.00(0.30)	1.00
MV	0.17(2.29)	1.18	0.15(1.82)	1.16	0.20(2.91) [c]	1.23
RELSIZ	-0.06(0.41)	0.95	-0.06(0.47)	0.94	-0.05(0.39)	0.95
N	293		293		293	
Log likelihood	53.41 [a]		55.17 [a]		58.42 [a]	
Pseudo -R^2	16.66%		17.16%		18.08%	

Table 7-10: OLS regressions of target industrial R&D intensity over 1998-2000

The dependent variable target industry R&D intensity is measured by target industry R&D expenditure/sales in the accounting year prior to acquisition announcement. FAB = fixed compensation and annual bonus in £million. LTIPCASH = LTIP cash award in £million. DELTA=the sum of the delta values of LTIP shares, options and ordinary shares in £million. $DELTA^2$ = the squared term of DELTA. DELTA*WEALTH = interaction of DELTA and WEALTH. WEALTH is measured as the sum of fixed compensation, annual bonuses, LTIP cash, LTIP shares, stock options and managerial shareholdings in £million. VEGA = stock option vega in £million. VEGA*WEALTH = interaction of VEGA and WEALTH. PAST = % of acquirer stock returns of month –2 versus month –12 (month 0 is announcement month). BEME = % of acquirer book value of equity to acquirer market value of equity. MEDIA= the weighted sum of the scores for newspaper articles that comment on acquirer directors over 3 years prior to acquisition announcement. BEME = % of acquirer book value of equity to acquirer market value of equity. LARSHR = % of large external shareholdings. NEXE = % of non-executive directors on acquirer board. NONDUAL = 1 if acquirer CEO and COB are different people and 0 otherwise. REM = 1 if an acquirer board has a remuneration committee and 0 otherwise. LEV = % of acquirer's total liability over total assets. MV = the natural logarithm of acquirer market value of equity. RELSIZ = natural logarithm of the ratio of the size of an acquirer to the size of its target. N = number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are the t statistics. The t-statistics in all three models are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	2.59(2.80)^a	2.61(2.84)^a	2.61(2.84)^a
FAB	-0.15(-1.61)	-0.13(-1.77)^c	-0.13(-1.55)
LTIP CASH	-0.34(-0.40)	0.05(0.06)	-0.00(-0.00)
DELTA	-0.05(-0.31)	1.15(2.51)^a	1.19(2.36)^b
$DELTA^2$		-0.21(-3.05)^a	
DELTA*WEALTH			-0.002(-2.97)^a
VEGA	0.45(0.27)	-0.28(-0.18)	0.03(0.02)
VEGA*WEALTH			-0.00(-0.51)
PAST	0.00(2.50)^a	0.003(2.34)^b	0.00(2.37)^b
BEME	-0.01(-1.73)^c	-0.01(-1.61)	-0.01(-1.61)
MEDIA	-0.03(-0.29)	-0.06(-0.53)	-0.06(-0.54)
LARSHR	0.00(0.42)	0.01(1.09)	0.01(1.07)
NEXE	-0.00(-0.07)	0.00(0.00)	0.00(0.02)
NONDUAL	-0.25(-0.78)	-2.64(-0.86)	-0.26(-0.84)
REM	-0.24(-0.45)	-0.39 (-0.75)	-0.39 (-0.74)
LEV	0.01(1.25)	0.01(1.11)	0.01(1.11)
MV	0.16(1.71)^c	0.12(1.31)	0.12(1.19)
RELSIZ	-0.14(-1.53)	-0.14(-1.52)	-0.14(-1.51)
N	293	293	293
F Statistics	2.20^a	2.64^a	2.45^a
Adjusted R^2	5.42%	7.78%	7.36%

where the dependent variable is proxied by target industry R&D intensity (see Section 6.5.1.2 for a discussion on OLS regression).

There are three models in each table depending on different combinations of wealth component variables. Model 1 only includes the linear term of equity delta (DELTA), consistent with Guay (1999), Rajgopal and Shevlin (2002), and Coles *et al* (2004). In Model 2, the squared term of equity delta term ($DELTA^2$) is added to the model so that any nonlinear impact of equity delta can be compared with the linear assumption in Model 1. In Model 3, the interaction of equity delta and wealth (DELTA*WEALTH) is added to Model 2 to further examine the impact of managerial wealth on risk incentives provided by equity-based wealth. Given that the square of equity delta ($DELTA^2$) is seriously correlated with the interaction of equity delta and wealth (DELTA*WEALTH) according to the multicollinearity detector VIF value (the values are higher than 5000 in both sample periods[140]), the square of equity delta ($DELTA^2$) is excluded in model 3 to avoid a multicollinearity problem.

The results show that there is no multicollearity problem as detected by VIF ratios in any of the models except Model 3 for the 1998-2000 sample (in Table 7-9 and Table 7-10). DELTA is correlated with DELTA*WEALTH. The VIF ratio for DELTA is 11.73, slightly higher than the generally accepted cut off point for a VIF ratio, i.e., 10. Given that the ratio is quite close to the cut off point and it is within the normal range for the 1993-1997 sample period, this moderately high ratio of 11.73 could be sample-dependent. Future studies are recommended to investigate the wealth variable using different datasets.

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[140] The cut off point of the VIF ratio is 10. The higher a reported VIF ratio is above 10, the more serious the multicollearity problem.

Following the discussions in Sections 6.5.1.2 and 6.5.1.3 of Chapter 6, I winsorize the variable outliers situated beyond the 2nd standard deviation from the sample mean to the 2nd standard deviation in all the models. The White (1980) heteroscedasticity test is conducted for all of the OLS regression models in Table 7-8 and Table 7-10 (see Section 6.5.1.2 of Chapter 6 for a discussion about the heteroscedasticity problem). The null hypothesis of no heteroscedasticity is not rejected at the 10% level for all the three models in the Table 7-8 but is rejected for all the three models in Table 7-10. Therefore, the test statistics for the models in Table 7-10 are corrected for heteroscedasticity by using the approach suggested by White (1980).

The following subsections discuss separately the association between the risk level of acquisitions and wealth incentives, behavioural biases, as well as monitoring mechanisms.

7.4.1 Wealth incentive

This section discusses the results for all the wealth-related variables.

Fixed compensation and annual bonus

The regression coefficients for fixed income and annual bonus (FAB) range from values of –0.13 to –0.35. Take Model 3 in the OLS regression over 1998-2000 (in Table 7-10) for example, the coefficient –0.13 means that for every million increase in acquirer directors' cash compensation, those directors decrease their criterion for the target R&D intensity by 0.13% in searching for an acquisition target. This indicates that cash compensation induces acquirer managers to undertake acquisitions that decrease their firm risk. The negative impact on managerial risk taking is more obvious with the higher pay levels of 1998-2000 as compared to 1993-1997. The results provide some support to the hypothesis *H1*, that acquisition risk is negatively related to the level of cash compensation. This finding is consistent with those argument presented by Gray and Cannella (1997), Narayanan (1996) and Bebchuk and Fried (2004, Part III) that fixed compensation and annual bonus provide managers with few incentives to undertake risky projects to improve firm performance. Instead, as suggested by Lewellen *et al* (1987) and Bizjak *et al* (1993) a high level of cash pay seems to encourage managerial risk avoidance.

Equity delta

When a linear relationship is assumed between managerial risk taking and equity delta (DELTA) in Model 1 from Table 7-7 to Table 7-10, the coefficients of equity delta are negative but insignificant for both sample periods, indicating that equity delta has no significant impact on encouraging managerial risk taking. This is consistent with the conclusions of Rogers (2002), and Coles *et al* (2004)[141]. Model 2 allows for a nonlinear relationship between acquisition risk and equity delta. Interestingly, the coefficients of DELTA become positive and significant at the 1% level when the dependent variable is target industry R&D intensity for both sample periods. Similarly, the squared term of equity delta ($DELTA^2$) that captures the nonlinear relationship is negative across all the regression models and is significant at the 1% level in OLS regressions. To interpret the results, I take the OLS regression over the sample period 1998-2000 as an example (in Table 7-10). When the pay-performance sensitivity, i.e., equity delta, is low, £1 million increase in equity delta can make acquirer directors increase their criterion for target firm R&D intensity by 1.15%, indicating that they will choose riskier firms as their acquisition targets.

[141] See Section 2.3.4.2 of Chapter 2 for a discussion of these two papers.

However, when the pay-performance sensitivity, i.e., equity delta is high, £1 million increase in equity delta can make directors decrease their criterion for target R&D intensity by 0.21%, indicating that they prefer to buy low-risk firms. These results strongly indicate that a concave relationship exists between acquisition risk and equity delta. Therefore hypothesis *H2* is supported[142].

The above finding suggests that when equity delta is low, it can drive directors to undertake risky acquisitions since directors can benefit from the success of projects, and the failure of the acquisitions will not substantially reduce the value of their equity holdings in their firms. However, as equity delta gets bigger, acquisition failure will have larger impact on directors' wealth. They then become more risk averse in their selection of acquisition risk. This finding supports those of Mishra *et al* (2000) who also document that the incentive provided by equity delta is nonlinear (see Section 2.3.4.2 of Chapter 2). This finding may also explain why empirical studies that ignore such a relationship, such as Coles *et al* (2004) and Roger (2002), do not find any significant effect from equity delta. See Section 2.3.4.2 of Chapter 2 for a discussion of these papers.

Interaction of equity delta and wealth

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[142] I acknowledge that the logistics regressions in Table 7-7 and Table 7-9 do not show statistically significant results. However, I suggest that the OLS regressions give a more robust result than the logistic regressions because the former allows for R&D intensity differences across target firms while the latter classifies all the acquisitions into two groups regardless how different each target firm is from the others.

The coefficients of equity delta (DELTA) are still positive and significant in OLS regression models (Model 3) when the cross term of equity delta and wealth (DELTA* WEALTH) is added to the models for both sample periods (see Table 7-8 and Table 7-10). The coefficients for the cross term are negative and are significant at the 1% level in OLS regressions whose dependent variable is target industrial R&D intensity. This result again shows that low equity delta does encourage managers to seek high-risk, high-tech acquisitions. This positive effect diminishes as managers' total wealth increases until it is totally dominated by the risk aversion effect from a high level of total wealth.

Robustness checks

One may argue that the wealth variable considered here which includes cash compensation, managerial shareholdings, LTIP cash and share awards, and stock options, overstates the actual assets at managers' disposal and therefore exaggerates the risk aversion effect arising from the wealth. LTIP cash and share awards as well as stock options are contingent in nature. Managers may not be able to cash them in if they fail to meet the conditions attached to those compensation plans (see Section 2.3.2 of Chapter 2 for a discussion of the vesting criteria of long-term incentive plans). Therefore adding LTIP cash and shares, and stock options to the managerial wealth portfolio may not add to managerial risk aversion[143]. I therefore reconstruct the measure for managerial wealth by excluding LTIP cash and shares, and stock options and run the same regressions as those are performed on the alternative measure for wealth. The results are reported in Table 7A-3.

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[143] Some other studies argue that LTIP shares and stock options increase managerial risk aversion because they accentuate the concentration of managers' wealth in one firm. See Section 2.4 of Chapter 2 for a discussion of this argument.

The interaction of equity delta and wealth (DELTA*WEALTH) is negative across all the models in both sample periods and is significant at the 1% in the OLS regressions whose dependent variable is target industry R&D intensity. This indicates that a high level of managerial wealth, which enhances a managerial risk aversion effect, can diminish or even override the risk incentive provided by equity holdings[144]. This finding is the same as when the measure of wealth includes all types of long-term incentive plans. Taken together, the above results support hypothesis *H4* that acquisition risk is not positively related to equity delta at a high level of managerial wealth. This finding provides empirical support to the theoretical argument presented by Ross (2004) that no incentive scheme can by itself make managers more or less risk averse since their attitude also depends upon their personal utility functions at different wealth levels.

It is also worth noting that equity-based wealth, managerial shareholdings in particular, is the major part of managerial wealth (see Table 7-2). Table 7A-1 also shows that the major component of equity delta is the delta for managerial shareholdings (SHARE DELTA). Section 6.2.1.2 of Chapter 6 explains that the delta for managerial shareholdings is in fact the value of managerial shareholdings divided by 100. Therefore, it appears that in this study, managerial wealth is seriously

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[144] Note that in the sample of this thesis, the major component of managerial wealth is managerial shareholdings. Equity delta is also dominated by managerial shareholdings. See Section 7.3 for discussions of the components of managerial wealth. Excluding long-term incentive plans from managerial wealth makes managerial wealth closer in value to managerial shareholdings. The negative impact of a high level of wealth on equity incentive may to a large extent come from the negative impact of managerial shareholdings at a high level. The nonlinear impact of managerial shareholdings on managers risk taking is discussed below.

correlated with equity delta and it is not surprising that regression Model 2 and Model 3 in Table 7-7 to Table 7-10 are very similar in terms of their coefficients and model explanatory power. Therefore the data in this study does not demonstrate a significant difference between the risk aversion impact of a high level of pay performance sensitivity and risk disincentive effect coming from a high level of managerial wealth. In reality, managers' equity ownership of their employer firms may not constitute such a large part of their personal wealth (see Section 2.3.1 for a discussion of managerial wealth). It is recommended that further studies should look into these matters when data on managerial wealth become available.

What this study can do is to examine how managerial wealth discourages the risk incentives provided by LTIP shares and stock options. I decompose equity delta into LTIP delta (LTIP DELTA), option delta (OPTION DELTA), and share delta (SHARE DELTA) and run the same regressions as those performed on equity delta (DELTA). The results are provided in Table 7A-4 to Table 7A-7 in the Appendix to this chapter.

LTIP delta (LTIP DELTA) has either insignificant coefficients in the regressions over 1993-1997 or significantly negative coefficients in the regressions over 1998-2000. Referring back to Table 7-2 for the descriptive statistics for LTIP shares, it is clear that they grew substantially between the 1993-1997 period and the 1998-2000 period. This is perhaps why a negative impact of LTIP delta is detected in the 1998-2000 sample period but not in the 1993-1997 sample period. Due to a multicollinearity problem between LTIP delta and the squared term of LTIP delta (see those tables in the appendix), the data does not allow me to test the concave relationship between acquisition risk and LTIP delta. Based on existing analysis of LTIP delta, I conclude that LTIP shares do not encourage managers to undertake risky acquisitions. In fact they may discourage managers from undertaking risky acquisitions. This finding provides empirical support to the argument of Smith and Stulz (1985) that the linear payoff structure of LTIP shares induces managerial risk aversion (see Section 2.3.2.3 for a discussion of this argument). This finding is consistent with that of Ryan and Wiggins (2002) who study the impact of LTIP shares on firm R&D investment, using the value term of LTIP shares rather than LTIP delta as a measure for the incentive provided by LTIP shares. However, the finding of this thesis is inconsistent with that of Richardson and Waegelein (2003) who find that following the adoption of LTIP share plans, firms increases their R&D investments. However, Richardson and Waegelein's approach is equivalent to the use a dichotomous variable for the presence of LTIP shares, which, as discussed in Section 2.3.3 of Chapter 2, is far too simplistic and does not fully capture managers' incentive to alter firm risk.

The coefficients of the cross term of LTIP delta and managerial wealth (LTIP DELTA*WEALTH) are insignificant in all Model 3s from Table 7A-4 to Table 7A-7. This means that the risk aversion effect from a high-level of total wealth does not affect the incentive provided by LTIP shares. LTIP shares hardly provide any incentives for managers to take risk in 1993-1997 (in Table 7A-4 and Table 7A-5) because of their low levels in both value and percentage of managers' total wealth (see Section 7.3.1). It is thus not surprising that a high level of managerial wealth does not have any disincentive effect on the incentive provided by LTIP shares over this period. In the 1998-2000 sample period (in Table 7A-6 and Table 7A-7), LTIP shares are found to discourage managerial risk taking [145]. The insignificant

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[145] This supports the argument of Smith and Stulz (1985) that LTIP shares increase managerial risk aversion (see Section 2.3.2.3 of Chapter 2).

provided by LTIP shares. Summarising the results for LTIP delta, I conclude that in the case of LTIP shares, the hypothesis (*H4*) that acquisition risk is not positively related to equity delta at a high level of managerial wealth is not rejected.

Option delta (OPTION DELTA) has both statistically and economically insignificant coefficients across all the models in the sample period of 1998-2000 as reported in Table 7A-6 and Table 7A-7. The squared term of option delta (OPTION DELTA^2), and the cross term of option delta and total wealth (OPTION*WEALTH) are also insignificant. These results show that the pay-performance relationship from stock options hardly has any effect on the riskiness of acquisitions pursued by managers. The risk aversion effect of managers' total wealth thus does not affect the incentive from stock options. Therefore in the case of stock options, hypotheses *H2* which suggests a concave relationship between acquisition risk and equity delta is not supported, and *H4* which states that acquisition risk is not positively related to equity delta at a high level of managerial wealth is not rejected.

According to Table 7A-4 to Table 7A-7, the coefficients for share delta exhibit a similar pattern to those of equity delta (in Table 7-7 to Table 7-10), indicating that the risk incentive effect of equity-based wealth is mainly contributed to by managerial shareholdings. The OLS regressions for both sample periods (in Table 7A-5 and Table 7A-7) demonstrate a significant (at the 1% level) nonlinear relationship between acquisition risk as measured by target industry R&D intensity and share delta as shown in the coefficients of SHARE DELTA and SHARE DELTA^2 . Table 7A-5 and Table 7A-7 show significant (at the 1% level) coefficients for the cross term of share delta and managers total wealth (SHARE DELTA*WEALTH), indicating that a high level of managerial total wealth negatively affects the incentive alignment effect of managerial shareholdings and induces managers to choose low-risk target firms.

However as in the case of equity delta, the data in this study does not demonstrate a significant difference between the risk aversion impact of a high level of share delta and the risk disincentive effect from a high level of managerial total wealth[145].

Although statistically share delta has a significant effect on managers' pursuit of acquisition risk, the impact of the economic term is trivial. When the share delta level is low, an increase of £1,000,000 in share delta makes managers increase their criterion for target firm R&D intensity by less than 0.01% during the period of 1993-1997. When the share delta is high, the same increase in share delta makes managers reduce their criterion for target firm R&D intensity by less than 0.005%. The economic impact remains the same even during the high-tech boom period of 1998-2000. Therefore, it appears that although the pay-performance sensitivity of LTIP delta and stock options alone does not have much effect on managers' preference of target firms' technology level because of their low levels both in terms of value and their percentages of managerial total wealth, combining them with the pay-performance sensitivity of managerial shareholdings can produce a both statistically and economically significant impact (see Table 7-7 to Table 7-10 for the evidence of equity delta). Overall, in the case of managerial shareholdings, the two hypotheses *H2* and *H4* are both supported.

As discussed in Section 2.3.4.2 of Chapter 2, it is common for existing studies to use the percentage of shares held by managers as a proxy for the incentive provided by managerial shareholdings. To provide comparable results with those studies, I use the percentage of the ordinary shares held by boards of directors in the accounting year prior to the acquisition announcement as a proxy for the risk incentive provided

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[145] To distinguish the difference between these two effects, one needs to combine Model 2 and Model 3 which as discussed in the beginning of this chapter, causes a serious muticollinearity problem.

by managerial shareholdings. The results are reported in Table 7A-8 – Table 7A-11. Strong evidence is found for a concave relationship between acquisition risk and the percentage of shares held by directors in the 1993-1997 sample period (in Table 7A-8 and Table 7A-9) but not in the 1998-2000 sample period (in Table 7A-10 and Table 7A-11). Therefore this study provides some results consistent with the finding of Wright *et al* (1996) that the impact of managerial equity ownership on managerial firm risk taking is nonlinear. In addition, Model 3 of the logistic regression model over the sample period of 1993-1997 (in Table 7A-8) reports a significantly negative (at the 5% level) coefficient for the cross term of percentage of share holdings and total wealth (MANSHR*WEALTH), indicating that a high level of total wealth can weaken the incentive provided by directors' equity ownership of their firms. To sum up, the alternative measure of managerial shareholdings provides some evidence that the impact of managerial shareholdings on managerial risk taking is concave, and that a high level of managerial total wealth diminishes the incentive alignment effect of managerial shareholdings.

Option vega

The signs of the coefficients of the sensitivity of managers' stock option holdings to stock volatility (VEGA) are mixed in the six regression models for the 1998-2000 sample period as shown in Table 7-9 and Table 7-10. None of the coefficients, however, is statistically significant. This means that although stock options protect managers' wealth from being affected by the reduced stock price as a result of highly risky projects, stock options do not drive managers to make more risky acquisitions. Therefore hypothesis *H3* that acquisition risk is positively related to the level of option vega is not supported.

Combined with the findings for option delta (OPTION DELTA) discussed earlier in this section, it appears that stock options have no impact on managers' pursuit of risky acquisitions. This finding is not in line with the findings of Guay (1999), Datta *et al* (2001), Rajgopal and Shevlin (2002) and Coles *et al*, (2004) who state that stock options encourage managerial risk taking. Among those studies, the analysis conducted by Datta *et al* (2001) is closer to the one by this thesis. They examine how stock options affect managers' decision of buying targets of higher growth opportunities as measured by targets' book-to-market ratio. For a sample of 1,719 completed acquisitions during the period 1993 to 1998, they report that acquirers with a higher level of stock options granted to their top five executives in the year prior to acquisition announcement buy targets with higher growth opportunities. Therefore, Datta *et al* conclude that stock options encourage corporate executives to undertake riskier acquisitions. Datta *et al*, however, use the value of stock options rather than stock option delta, or vega to measure the stock option incentives, which as criticised by Core and Guay (1999) and Guay (1999) as an inappropriate representative as the incentive provided by stock options (see Section 2.3.3 of Chapter 2).

Moreover, the finding of this thesis that stock options do not provide risk incentives to managers also does not support the argument put forward in Section 2.3.2.4 of Chapter 2 that the excessive grant of stock options in the 1990s drove managers to engage in excessive risk taking. A possible explanation for this could be that the level of stock option compensation in the UK is too low to have any effect on managers' investment behaviour, as suggested by Conyon and Murphy (2000) (see Section 2.3.1 for a discussion of Conyon and Murphy's findings). Mehran *et al* (1998) also address a similar issue. By examining voluntary corporate liquidations by managers, they state that stock option compensation should be large enough to motivate managers to forego the present value of future compensation and the consumption of perks in their current firm[146].

Interaction of option vega and wealth

The coefficients for the interaction between vega and wealth (VEGA*WEALTH) are insignificant in both Table 7-9 and Table 7-10. Using an alternative measure of wealth which does not include the contingent wealth such as LTIP cash, LTIP shares and stock options, the coefficient for VEGA*WEALTH in the logistic regression model is positive and significant at the 10% level (see Table 7A-3 in the Appendix to this chapter), indicating that a high level of wealth does not diminish the risk seeking effect of stock options. This evidence however is not found in the OLS regression model. Overall, three out of four models in Table 7A-3 show that a high level of total wealth has no impact on the risk-seeking incentive offered by stock options. With the pay-risk relationship of stock options, i.e., vega, not providing any significant risk incentive as discussed above, it is not surprising that a high level of managerial total wealth does not affect the risk incentive embedded in stock options. Therefore hypothesis *H5* that acquisition risk is not positively related to stock option vega at a high level of managerial wealth, is not supported by this study. However, this does not mean that managers' wealth does not affect the risk incentive provided by stock options at all. It would be valuable for future studies to investigate the impact of wealth on vega using US data, where option grants are far

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[146] See section 4.2.2.1 of Chapter 4 for a discussion of Mehran *et al* (1998).

more popular than they are in the UK, or with more recent UK data reporting an increase in option grants.

LTIP cash

For both sample periods, the coefficients of LTIP CASH are negative across all the regression models, but they are all statistically insignificant. Therefore hypothesis *H6*, that acquisition risk is positively related to the level of LTIP cash, is not supported. The results show that LTIP cash awards do not encourage managers to undertake risky acquisitions. Table 7-2 shows that the average value of LTIP cash is no more than £10,000 for the whole board of directors of both types of acquirers and the median value is less than £1,000 in both sample periods. Such a low level of LTIP cash is unlikely to have much of an effect on directors' investment behaviour.

Robustness checks: regressions of size-deflated wealth variables

Earlier literature such as Cosh and Hughes (1975) suggests that compensation levels varies across firms. Therefore empirical studies such as Williams and Rao (2000) and Guay (1999) generally adjust compensation level by a firm size variable such as total assets. Coles *et al* (2004) use the value term for the compensation variables instead of a ratio like Williams and Rao (2000) and Guay (2000) because firm size is a variable in their regression models, which, they argue, captures the cross-sectional firm differences in compensation level. The wealth variables in the regression models discussed so far follow Coles *et al*'s approach, i.e., all based on value terms, since size is also a variable in the empirical risk model (Model 6-1 in Chapter 6). Nevertheless I also adopt the other authors' approach and deflate all the wealth variables such as cash compensation (FAB), LTIP cash (LTIP CASH), equity delta (DELTA), vega (VEGA), and total wealth by acquirers' total assets in the accounting year prior to acquisition announcement. The same regression models are run as those performed on unadjusted wealth variables. The results are reported in Table 7A-12 –Table 7A-15 in the Appendix to this Chapter.

Comparing with the outputs of Table 7-7 to Table 7-10, which are based on the unadjusted wealth variables, the findings with regard to the effect of the components of directors' wealth on the acquisition risk pursued by managers are generally similar. Both show that cash compensation does not encourage managerial risk taking. LTIP cash does not have much of an impact on managers' pursuit of acquisition risk. The pay-performance sensitivity, i.e., equity delta has a concave impact on managerial risk taking. The regression models based on the adjusted wealth variables show this pattern but do not achieve statistical significance. They however provide significant evidence that a high level of managerial wealth diminishes the risk seeking incentive from pay-risk sensitivity from stock options, i.e., option vega (in Table 7A-14 and Table 7A-15). Therefore hypothesis *H5* that acquisition risk is not positively related to stock option vega at a high level of managerial wealth, is supported when the option vega is adjusted for firm size.

Summary

Taken together, the analysis of the impact of the components of managerial wealth on acquisition risk pursued by directors show the following results:

- Fixed compensation and annual bonus provide few incentives for managers to undertake risky acquisitions. On the contrary, it can discourage managers from conducting risky, high-tech acquisitions.
- LTIP cash also does not provide any incentives for managers to take risk.

- The pay-performance link embedded in managers' equity-based wealth and measured by equity delta has a nonlinear impact on managers risk preference for high-tech or low-tech acquisitions. At a low level, equity delta aligns the interests of managers and shareholders and encourages managers to buy high-technology targets to quickly achieve technological breakthroughs. However when equity delta is already high, an increase in its value intensifies managerial risk aversion and diverts managers away from high-tech acquisitions which have more uncertain outcomes than low tech acquisitions.
- The detected nonlinear impact of equity delta is due to a large extent to managerial shareholdings which are the dominant component of managers equity-based wealth. This result is robust when an alternative measure of managerial shareholdings, i.e., the percentage of share held by directors, is used.
- The level of LTIP shares and stock options held by directors are generally too low to have much of an impact on managers' selection of acquisition risk, although evidence is found in the 1998-2000 period that LTIP shares discourage managers to pursue high risk acquisitions. The insignificant effect on managerial risk taking found with stock options shows that the broad criticism of excessively granted stock options inducing managerial excessive risk taking in the US in the 1990s does not apply to the UK.
- Evidence is found that a high level of managers' wealth diminishes the incentives provided by equity-based wealth to undertake risky projects that enhance firm value. The above conclusion is robust when an alternative measure of total wealth, which excludes all the contingency compensation plans, is used. It is also recommended that future studies should explore this area with more complete data

for total wealth including the wealth components related to firms other than managers' employment firms.

- The above conclusions are consistent when all those variables are adjusted by the total assets of acquirers prior to acquisitions to capture the cross sectional difference in compensation levels related to firm size.

Overall, the findings of this thesis are more consistent with the asset concentration argument discussed in Section 2.4 of Chapter 2, i.e., that compensation contracts actually lead managers to reduce the risk profile of the firms they manage so as to protect their own personal wealth tied to the firms. As the model by Marcus (1982) states, this seemingly suboptimal behaviour is in fact optimal given the non-diversification of managerial wealth based on executive compensation.

Discussion

The above findings for the various components of managerial equity-based wealth indicate that equity-based wealth is an ineffective means of encouraging managerial risk taking. Existing studies provide a variety of explanations for why this might be so in addition to the argument that in the UK, option holdings by board of directors are far to low have any significant impact on managers' investment behaviour as discussed in the previous section.

Firstly, the strongest argument lies in management manipulation of compensation schemes. Many researchers argue that senior directors have substantial influence over their own pay, with little oversight from shareholders (Healy, 1985; Yermack, 1997; Campbell and Wasley, 1999; Bertrand and Mullainathan, 2001; Murphy, 2001; Bebchuk and Fried, 2004, Chapter 7 and Chapter 14). Some researchers discover that members of the board of directors (some of whom are members of the compensation committee) serve at the discretion of the CEO (Shivdasani and Yermack, 1999; Baker *et al*, 1988).

Yermack (1997) finds that managers are more likely to receive an option grant prior to significant improvements in the market performance of the firm. He suggests that managers who become aware of favourable information about the firm try to influence the board to grant more performance-related pay. Aboody and Kasznik (2000) show that managers which delay disclosure of good news and accelerate the release of bad news prior to stock option grant dates, presumably do so in an attempt to lower the option exercise price. Carpenter and Remmers (2001) find that managers exploit inside information to time their option exercises and firms experience significantly positive abnormal returns before they exercise their stock options. Bens *et al* (2002) suggest that managers cut research and development expenditure to fund share repurchases for option plans so as to avoid EPS dilution.

Bebchuk and Fried (2004, Part II) provide a systematic analysis of executive compensation. They propose a 'managerial power' hypothesis. They claim that board of directors who have been nominated by management, are sympathetic to executives, are insufficiently motivated to bargain over compensation, or are simply ineffectual in overseeing compensation. *Essentially managers set their own compensation.* As a result, executive pay greatly exceeds the levels that would prevail if directors were loyal to shareholder interests. Bebchuk and Fried state that even though directors are under a fiduciary duty to maximise shareholder wealth, executive compensation arrangements often fail to provide executives with proper incentives to do so and may even cause executive and shareholder interests to diverge. Overall, Bebchuk and Fried conclude that existing compensation schemes are a failure. They therefore advocate a radical reform in the structure of compensation practice with strong emphasis on making them more transparent to investors and less easy to be manipulated by managers.

Secondly, firms issue stock options for purposes other than aligning the interests of managers and shareholders, for instance, to reduce reported accounting expense (Hall and Murphy, 2002). Bender (2004) conducted an interview-based research to determine why companies use performance-related pay. Her study, based on interviews at 12 UK companies with 35 individuals involved in setting directors' remuneration, finds that firms believe that money does not actually motivate executives and they adopt performance-related pay only to follow the market practice. By following the market practice in structuring their executive packages, companies do not stand out from the crowd, and are likely therefore to draw support from relevant constituencies, in particular institutional shareholders.

The third explanation is from a methodology perspective. The Black-Scholes (1973) option pricing model overstates the value of options to risk averse executive recipients (Conyon and Murphy, 2000). The reasons are as follows. Firstly, executive share options are subject to forfeiture if the executive leaves the firm prior to vesting. In this case, stock options are worthless. Secondly, the value of options to both the company and its directors will also be affected by the presence of performance criteria that determine whether the share options will vest or not. Conyon and Murphy (2000) observe that share options granted in the UK typically vest only upon attainment of some performance criteria, often based on earnings-per-share growth. Moreover, (Murphy, 1999) state that the Black-Scholes model ignores the possibility of early exercise, which may have either a positive or negative effect on the value of the option. Furthermore, Conyon and Sadler (2001) state that even if Black-Scholes (1973) model is an accurate way of measuring executive incentives, there still exists an under/over-estimation of the size of the risk incentive of options due to incomplete disclosure about option related information in both UK and US[147]. This suggests that existing evidence with regard to the option incentive may be distorted.

Taken together, the existing studies show that executive compensation could be ineffective due to a number of reasons, such as top management power, inadequate measurement in empirical studies, insufficient information disclosure with regard to the director's pay, etc.

7.4.2 Behavioural biases variables

As shown in Table 7-9 and Table 7-10, the regression coefficients of the terms representing past stock performance (PAST) are positive and are highly significant at the 1% level in the 1998-2000 sample period when the stock market peaked. In the logistics regression models as reported in Table 7-9, the odds ratio for PAST is 1 in all the three models. This means that a stock performance increase of 1% over the past year can increase the probability that managers will select a high-tech acquisition versus a low-tech acquisition by 1%. In the OLS regressions as reported in Table 7-10, the coefficients for PAST are 0.003 across all the models, meaning that a 1% increase in companies stock return over one year can make managers increase their

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[147] See Section 6.2.1.2 for a discussion of this issue. The Greenbury Report (1995) states that UK companies can adopt two types of disclosure for directors' holding of stock options, namely complete disclosure and concise disclosure. A complete disclosure reports all the parameters in the Black-Scholes (1973) option pricing model. A concise disclosure may only report the weighted average excise price for the unexercised options held by directors instead of the exercise price for each tranche of stock options. Researchers have to make assumptions about some parameters if a company adopts the concise disclosure method.

criterion for the R&D intensity of a target firm by about 0.003%. Using both regressions thus gives us, for a given improvement in acquirers' stock returns, the likelihood that directors may choose a high-tech acquisition versus a low-tech acquisition, as well as the magnitude of the technology level of a target firm that affects acquirer directors' decisions to buy a target.

The above result indicates that good past performance which gives directors overconfidence in their management skills increases the probability that managers will buy high-risk target firms. This is particularly true during the bull stock market of late 1990s when firms achieved hyper stock performance possibly leading directors of those firms to believe that they are capable of doing anything. This finding is consistent with the argument of Hayward and Hambrick (1997) and other studies discussed in Section 3.3 of Chapter 3 and Section 5.5 of Chapter 5, that good past performance can encourage managerial overconfidence/hubris which then makes managers seek risk.

The coefficients of acquirers' glamour status (BEME) are significantly negative across all the models except in two OLS regression models for the 1998-2000 sample period when the proxy for acquisition risk used is target industry R&D intensity. Even in those two models, the coefficients are close to the 10% significance level. The odds ratio for BEME in the logistic regressions in the 1993-1997 sample period is 0.98 (in Table 7-7), meaning that a 1% decrease in the book-to-market ratio, i.e., the market views the acquirer firm as more of a rising star (a glamour firm) than as a mature firm lacking growth opportunities (a value firm), can increase the probability that acquirer directors will choose a high-tech target over a low-tech target by 0.98%. This shows that acquirers with a high glamour rating in the stock market make more risky acquisitions. This finding is consistent with that of Kohers and

Kohers (2001). The impact of glamour rating on directors' selection of risky acquisitions is more dramatic in the 1998-2000 sample period which covers the bull stock market. This is reflected in a higher odds ratio, 0.99 (in Table 7-9), implying that over-optimism/overconfidence engendered by firms' glamour rating is more prevalent during telecom bubble period.

The coefficients for media praise (MED) have mixed signs across all the regression models. However they are significantly positive in the 1998-2000 sample period when the proxy for risk is target high-tech industry status. This indicates that media praise drives managers to take more risks when the stock markets are riding high. This finding is consistent with the descriptive statistics reported in Table 7-4 which show that the media portrays acquirers in the high-tech acquisition group substantially more favourably than acquirers in low-tech acquisition group in the telecom and internet bubble period of late 1990s. The flattering media profile enhances directors' perceptions of self-importance and self-esteem, and leads them to undertake high-risk, high-tech acquisitions. By contrast, directors of firms who receive fewer flattering media comments are more cautious about their ability to manage risky projects and therefore go for low-risk, low-tech acquisitions. The mixture of signs across the different regression models, however, may be due to noise associated with the process of the construction of the variable for media praise, which is quite subjective. A more objective approach is recommended for future studies, such as involving more researchers in the coding process, or involving the assistance of computer software for content analysis.

The conclusions for those three behavioural bias variables are the same in the robustness check models reported in Table 7A-3-Table 7A-16 in the Appendix to this chapter. In summary, the above analysis finds strong evidence that behavioural biases such as overconfidence, over-optimism and hubris, encouraged by acquirers' good past performance, glamour status and high media profile drive managers to undertake risky high-tech acquisitions. More significant evidence is found in the 1998-2000 sample period which corresponds to when the stock market was bullish, a condition likely to strengthen the behavioural biases. This supports hypothesis *H7* that acquisition risk is positively related to behavioural biases. Compared with the findings for the wealth variables, it appears that managers' decisions regarding the undertaking of risky high-tech acquisitions in the UK in the 1990s is mainly driven by behavioural biases rather than the equity-based wealth such as stock options which are supposed to be 'designed' to promote managerial risk taking.

This study, along with other behavioural finance studies such as Hayward and Hambrick (1997), Heaton (2002), Malmendier and Tate (2004) and Malmendier and Tate (2005a)[148] provide empirical evidence for how directors' behavioural biases can affect firm strategy. This thesis advances the studies of Hayward and Hambrick (1007) and Malmendier and Tate (2004) in that it examines to what extent managerial behavioural biases contribute to managerial risk taking, an issue not covered by those two studies. In fact, those studies examine the impact of managerial behavioural biases and post-acquisition performance assuming that managerial risk taking influenced by behavioural biases leads to negative firm performance. This thesis also considers the other influence of managerial wealth and corporate monitoring mechanisms on managers' risk taking behaviour, which again is not highlighted in those two studies.

[148] See Section 3.3 of Chapter 3 for a discussion of these studies.

The evidence presented in this thesis that managers' project selection is largely influenced by their behavioural biases found also implies that studies attempting to predict the optimal investment risk within the traditional agency framework, such as Rajgopal and Shevlin (2002), Rogers (2002), Coles *et al*, (2004), may be subject to model misspecification problems as a result of ignoring behavioural variables.

Discussion

The above analysis of the impact of behavioural biases is not without shortcomings. Psychological biases are difficult to quantify. Although the measures for behavioural biases do generate significant results, whether or not stock price momentum, book-to-market ratio, and/or media comments can boost overconfidence/over-optimism/hubris in managers is an issue worth further investigation. Table 7-1 shows that for both sample periods, over 70% of the acquirers in the high-tech acquisition group are in high-tech industries and over 80% of the acquirers in the low-tech acquisition group are in low-tech industries. It is likely that the selection of high-risk technology-rich acquisitions may have little to do with the behavioural biases driven by good past performance and glamour status but rather because firms are more likely to buy targets with similar characteristics to themselves, i.e., firms in the same industry as themselves.

In addition, the content analysis conducted to obtain values for the media praise variable is quite subjective. Hayward and Hambrick (1997) have two researchers independently read and code each of the 138 articles. Any disagreements regarding the coding were discussed until both researchers reached consensus. Due to the large number of articles identified for acquirers in the sample of this thesis (14,053 articles read in total and 1,287 read in detail and coded), it was difficult for me to find volunteers to assist in the task of coding and follow Hayward and Hambrick's approach. Further empirical studies are recommended to examine the robustness of these variables and to investigate the effect of managerial behavioural biases on firm strategy.

7.4.3 Monitoring mechanisms

This section provides results for monitoring mechanisms.

External blockholders

The sign of the regression coefficients for external blockholding (LARSHR) is not consistent across the range of models and the coefficients are insignificant both economically and statistically for most of the models, indicating that that external blockholders do not perform a strong monitoring of the managers' pursuit of acquisition risk. They neither curb managerial risk avoidance nor managerial excessive risk taking through acquisitions. Therefore hypothesis *H8* that the higher the level of external blockholdings the more likely the acquisition risk is at an optimal level, is not supported. This is inconsistent with the findings of Hill and Sneil (1988) who suggest that external blockholdings influence firm R&D investment, and by Tufano (1996) who documents that external blockholders can curb managerial risk avoidance and make managers hedge gold price risk less. The finding in this thesis also does not support the view of Hayward and Hambrick (1997) that external blockholders can prevent overconfidence/hubris infected directors from seeking excessive risk and conducting value destroying acquisitions. However, these two studies are both based on US data. Compared with UK based studies, this thesis draws a conclusion about monitoring by external blockholders similar to those of Sudarsanam *et al* (1996), Franks *et al* (2001) and Weir *et al* (2002) who all state that external blockholders are ineffective monitors in the UK (see Section 4.2.1 of Chapter 4 for discussions of the above studies).

Institutional blockholders

To gain further insight into the monitoring by external blockholders, I examine the role of institutional blockholders, which are the major type of external blockholder. The same regressions are run on institutional blockholders as those performed on external blockholders. Regression results are reported in Table 7A-16 in the Appendix to this chapter. Note that only Model 3 performed on external blockholders (see Table 7-7 – Table 7-10) is reported because the other two models produce very similar results to Model 3 for institutional blockholders. The coefficients for institutional blockholders (INSTSHR) are insignificant both statistically and economically across all the four models, indicating that institutional blockholders do not exert any disciplinary impact on either managers' risk avoidance or excessive risk seeking through acquisitions. Therefore institutional blockholders are equal to external blockholders as a whole in their ineffectiveness as serving corporate monitors.

The above finding is not in line with that of Zahra (1996) who finds that institutional shareholders encourage entrepreneurial risk activities in a firm, or in line with the finding of Wright *et al* (1996) that institutional shareholders can encourage managerial risk taking which in turn affects firm risk levels and make analysts' forecasts of firm performance more volatile. The finding of this thesis does not support the view of Malmendier and Tate (2005a) who find that external blockholders prevent overconfidence/hubris affected directors from conducting corporate activities that are not in the best interest of shareholders.

However, this study draws the same conclusion as Cosh and Hughes (1997) who find that institutional blockholders in the UK are ineffective monitors. This finding on institutional shareholders, together with those on UK external blockholders, and the finding of Franks *et al* (2001) that the main source of large shareholder control comes from the shareholdings which lie in the hands of inside managers and which are used to entrench rather than to discipline management, all advocate an improvement in shareholder monitoring in the UK.

Board composition

The coefficients of board composition measured by the percentage of non-executive directors on the board (NEXE) are also both economically and statistically insignificant in all the regression models. Therefore hypothesis *H9*, that the higher the proportion of non-executive directors on the board the more likely the acquisition is at an optimal level is not supported by the empirical results of this study.

The above finding adds to the division of views with regard to the monitoring role of non-executive directors. It supports the argument of Mace (1971) that non-executive directors may be little more than a 'rubber stamp', and is also consistent with the empirical findings of Cosh and Hughes (1997), Weir (1997), Weir and Laing (2000), Franks *et al* (2001) and Weir *et al*(2002) (see Section 4.2.2 of Chapter 2 for a discussion of these studies).

Hayward and Hambrick (1997) find that a higher percentage of non-executive directors can prevent hubris stricken directors from seek excessively risky and value destroying acquisitions. This study, however, does not find evidence that non-executive directors can prevent managers' excessive risk taking arising from behavioural biases. Rau and Vermaelen (1998) suggest that good past performance achieved by executive directors can make non-executive directors believe that strategies pursued by the executives are correct even if those strategies have come about as a result of executive directors' hubris. This may be one of the explanations for why this study does not find monitoring by non-executive directors to be effective. Another explanation may be that UK non-executive directors are more like 'advisors' than 'controllers' because the powers to enforce fiduciary responsibilities on directors in the UK are weak (Franks *et al*, 2000) (see Section 4.2.2 of Chapter 4 for a more detailed discussion). A number of other possible explanations are presented in Section 4.2.2 of Chapter 4.

Overall, the findings of this thesis together with those of other empirical studies that find that non-executive directors do not effectively perform their disciplinary role on executive directors call for an improvement in the corporate governance by UK non-executive directors.

CEO-COB non-duality

The coefficients of the CEO-COB non-duality variable (NONDUAL) are insignificant across all the models. Therefore, separation of the roles of CEO and chairman (NONDUAL) appears not to have any impact on managers' preferences regarding acquisition risk. Therefore, hypothesis *H10* that when there is non-duality of CEO and COB it is more likely that the acquisition risk is at an optimal level, is not supported by this study. This parallels the findings of Brickley *et al* (1997), Coles and Jarrell, 1997, Weir *et al* (2002) and Dahya (2003) that duality has little impact on firm performance.

Remuneration committee

The coefficients for remuneration committee (REM) are insignificant in all of the regression models. They also have mixed signs. Therefore hypothesis *H11* that when there is a remuneration committee of the company board it is more likely that the acquisition risk is at an optimal level, is not supported. It is concluded that remuneration committees generally have no impact on managerial risk taking. This is in contrast to the findings of Main and Johnson (1993), Klein (1998), and Weir and Laing (2000), who state that the presence of remuneration committee has a positive impact on firm performance, i.e. remuneration committees are good corporate monitors. In a separate analysis that links firm performance to the presence of remuneration committees, such as studies by Main and Johnson (1993), Klein (1998), Weir and Laing (2000), I still find that the presence of remuneration committees has no impact on acquirer post-acquisition performance. See Section 8.6 of Chapter 8 for the result of this analysis. Overall, this thesis finds that remuneration committees are ineffective corporate monitors. My results however are consistent with the view of Bebchuk and Fried (2004, Part II) that managers essentially set their own compensation, the remuneration committee only serving as a 'rubber stamp'.

Taken together, none of the monitoring mechanisms outlined above has a strong disciplinary influence on managers with regard to their pursuit of acquisition risk. This conclusion supports the argument put forward by Bebchuk and Fried (2004, Chapter 16) that a radical reform is needed to improve corporate monitoring systems.

Discussion

Empirical studies have provided many explanations why external monitors might be ineffective. Section 4.2.1 of Chapter 4 suggests that different types of external blockholders have different attitudes towards their monitoring roles. Family and individual shareholders may only hold shares as a passive investment. Institutional shareholders however are themselves agents and are subject to agency conflicts of their own. Therefore it is not surprising that this study find that external blockholders have no impact on managerial risk taking.

With regard to non-executive directors or a non-executive chairman, Section 4.2.2 of Chapter 4 states that they may actually be under the control of executive directors, and that different types of non-executive directors may perform different monitoring roles. For example, representatives of financial institutions or major customers are likely to have more power than representatives from universities, civil rights groups, etc. Methodologically, Byrd and Hickman (1992) find that a two way classification of directors (i.e., outside and inside classification without taking affiliation into account) misses important empirical relationships because they mis-specify the director categories. They therefore propose a three-way categorisation: inside directors, affiliated outside directors and independent outside directors. Therefore, a further research into this area will necessitate an appropriately detailed level of classification of non-executive directors.

As with non-executive directors, the members of a remuneration committee may also under the control of executive directors thereby having little monitoring power (Bebchuk and Fried, 2004, Chapter 7 and Chapter 14). As discussed in Section 7.4.1 above, it appears that executive directors essentially set their own incentive schemes. If this is the case, it is not surprising that this study does not find evidence that the presence of remuneration committees controls directors' acquisition decisions.

7.4.4 Other incentives

The coefficients for leverage (LEV) are both economically and statistically insignificant in all of the regression models, indicating that financial leverage does not create incentives for managers to assume risky projects, either to efficiently use the free cash flows in the firm (Jensen, 1986; Novaes, 2003) or to transfer the wealth from debt holders to shareholders (Harris and Raviv, 1991; Leland, 1998; Rajgopal and Shevlin, 2002).

The coefficients for acquirer size (MV) have mixed signs across the range of models. Therefore it is not certain whether bigger companies are more likely to take more risks than smaller companies. This does not support the size argument proposed by Moeller *et al* (2004) that firm size affects the risk an acquirer will bear. This study suggests that big acquirers are not necessarily more keen to go for riskier projects.

The coefficients for the relative size of acquirer to target (RELSIZ) are insignificant across all the regression models. This finding neither supports nor rejects the argument that when target firms are small relative to acquirers, the acquiring firms are more likely to buy the target even if the risk of the acquisition failure is high.

7.4.5 Overview of models results

The results from the models suggest that directors' pursuit of high-risk, high-tech acquisitions in the UK in 1990s is mainly driven by their behavioural biases, such as overconfidence/over-optimism/hubris rather than being driven by managers' equity-based wealth incentives, such as stock options which are 'designed' to promote managerial risk taking. None of the monitoring mechanisms has much impact on disciplining managers' decisions on acquisition risk.

Comparing the regression models for the 1993-1997 sample with those based on the 1998-2000 sample, the latter period appears to exhibit more managerial overconfidence/over-optimism/hubris than the former. It is not surprising given that 1998-2000 contains the peak of the bull market during which equity was overly valued by the market and managerial overconfidence/hubris/over-optimism drove M&A activities to a historic high. Examples of such acquisitions include the mega merger of AOL and Time Warner in 2000, which aimed to take a traditional media company into a brand new area, online media services. The acquisition failed after one year. One of the reasons is because Steve Case, the chairman of the merged company, overestimated the technology capabilities Time Warner could offer to AOL (BBC News, 13 January 2003). Vivendi Universal is another example. Jean-Marie Messier, the CEO of Vivendi Universal, conducted a series of acquisitions to establish a world's leading media empire based on a 150-year-old French water company within 8 years from 1994 (Johnson and Orange, 2003). The media empire did not survive for long and Jean-Marie Messier was convicted of fraud.

From the overall model perspective, Model 2 and Model 3 have much higher explanatory power (see Pseudo R^2 or adjusted R^2) than Model 1 in each of the regressions of acquisition risk. Due to the multicollinearity problems in this study, it has not been possible to combine Model 2 with Model 3, although the combined model would be more predictive than the two separate models. In this study, only regression Model 3 is used as the prediction model for optimal acquisition risk levels due to the fact that Model 3 accounts for the effect of managerial wealth on equity incentives. However, I did also try Model 2 as a prediction model. The results appear to be the same as those based on regression Model 3 in generating the optimal risk level for acquisitions. It is recommended, if data allows, that future studies use a combination of Model 2 and Model 3, which includes both the squared term of equity delta and the cross term of equity delta and total wealth as the prediction model.

Comparing the prediction power of the logistic regression and OLS regression models, OLS regression is arguably more reliable because it captures the cross-sectional difference in target firm technology levels, whereas logistic regression by categorising all the acquisitions into either high-tech acquisitions or low-tech acquisitions, misses out a large amount of information that distinguishes individual acquisitions from one another[149]. This thesis uses target industry R&D level to proxy for acquisition risk in the OLS regressions. This is because firm level data is unavailable (see Section 6.2.1.1 of Chapter 6). I acknowledge that using industry level data misses out the different R&D levels cross target firms. It is recommended that future studies use firm level data.

7.5 Summary

This chapter presents the descriptive statistics for each of the variables in the sample and reports the results produced by the empirical risk model (Model 6-1).

Target industry R&D intensity is significantly higher for high-tech acquisitions than it is for low-tech acquisitions. There is no significant difference between the transaction sizes, acquirer sizes or the relative sizes of acquirer to target between the two acquirer groups. Pure cash financing is used less frequently in high-tech acquisitions than in low-tech acquisitions. Over 90% of the targets are non-listed firms.

Fixed compensation and annual bonuses are significantly higher for acquirers in the low-tech acquisition group for both sample periods. Equity-based wealth or

[149] OLS regression and logistic regression are discussed in Section 6.5.1.

overall wealth is significantly larger for acquirers in the high-tech acquisition group in the 1998-2000 sample period. Stock options are just a small part of UK directors' wealth.

Factors that encourage managerial overconfidence/over-optimism/hubris such as good past stock performance, glamour status and media praise are significantly more influential with acquirers that conducted high-tech acquisitions than with acquirers that undertook low-tech acquisitions, particularly in the 1998-2000 sample period.

Acquirers of high-tech targets have less external blockholder or institutional blockholder control. There is little difference in other corporate monitoring mechanisms (such as the percentage of non-executive directors on the board, separation of the roles CEO and Chairman, and the presence of a remuneration committee) between acquirers of high-tech targets and acquirers of low-tech targets.

No significant financial leverage difference prior to acquisitions can be seen to distinguish acquirers conducting high-tech acquisitions from acquirers initiating low-tech acquisitions.

In the regression models, none of the components of managerial wealth portfolios encourages managerial risk seeking, except for a low level of equity delta. However when equity delta is high, it induces managerial risk aversion. A high level of managerial wealth can in fact diminish the incentives produced by managers' equity holdings. Fixed compensation and annual bonuses do not encourage managerial risk taking. In fact they can discourage managers fro pursuing risky high-tech acquisitions. Managerial overconfidence/over-optimism/hubris induced by good past performance, glamour status and media praise drives managers to undertake high-risk, high-tech acquisitions, particularly in the 1998-2000 sample period which corresponds to when the bull market is at its peak. None of the monitoring mechanisms has much impact on disciplining managers regarding their acquisition risk choices. Financial leverage, acquirer size or relative size of acquirers to target does not have any impact on managers' choice of risky acquisitions.

The next chapter examines the effect that managerial risk taking in acquisitions has on company performance, where Model 3 in Table 7-7 to Table 7-10 is used as the prediction model for the optimal level of acquisition risk.

Appendix

Table 7A-1: Summary descriptive statistics for the deltas of LTIP shares, stock options and managerial shareholdings

This table reports the descriptive statistics for the deltas for LTIP shares, stock options and managerial shareholdings of acquirers' boards of directors prior to acquisition announcement. Panel A reports the data for the acquisitions over 1993-1997 and Panel B reports data for the acquisitions over 1998-2000. LTIP delta = the delta value of LTIP shares in £thousand. Share delta = the delta value of managerial shareholdings in £thousand. See Section 6.2.1.1 for calculation approaches for those delta values. MANSHR = the percentage of shares, beneficial and non-beneficial, held by acquirer board of directors in the accounting year prior to acquisition announcement. N = number of acquisitions. In parentheses are the t statistics (mean difference) or Wilcoxon rank sum test z statistic (median difference). All the tests are based on two-tailed tests. a, b,c indicate the significance at the 1%, 5% and 10% level respectively.

	Panel A: Acquisitions 1993-1997							
	High-tech acquisitions			**Low-tech acquisitions**			**Group difference**	
	Mean	**Median**	**N**	**Mean**	**Median**	**N**	**Mean (t stat)**	**Median (z stat)**
LTIP DELTA	0.24	0.00	124	0.31	0.00	161	-0.07 (-0.3)	0.00 (-0.5)
SHARE DELTA	114.59	47.22	124	135.84	33.86	161	-21.24 (-0.6)	13.36 (0.7)
MANSHR	15.22	8.93	124	13.37	4.67	161	1.85 (1.0)	4.26 (2.1)[b]
	Panel B: Acquisitions 1998-2000							
LTIP DELTA	2.73	0.00	165	9.42	0.00	128	-6.68 (-1.8)[c]	0.00 (-3.0)[a]
OPTION DELTA	33.54	8.24	165	18.58	4.20	128	14.95 (1.8)[c]	4.04 (2.2)[b]
SHARE DELTA	337.95	94.42	165	550.40	61.61	128	-212.45 (-0.9)	32.81 (2.1)[b]
MANSHR	14.66	9.44	165	13.27	5.93	128	1.39 (0.7)	3.51 (1.4)

Table 7A-2: Descriptive statistics for the coding of the media praise variable

The table lists the descriptive statistics for the scores given to each article to construct the media praise variable (MEDIA). See Section 6.2.1.3 for a discussion of the coding process and criteria. Unless otherwise specified, the statistics given in the table are the number of articles with a given score, e.g., 3 points, 2 points, etc as a % of the total number of articles coded for an acquirer. 'Total read articles' refers to the total number of articles initially produced by Factiva. 'Total coded articles' refers to those relevant articles identified for coding. 0 point is given to those acquirers which have no relevant articles.

	Panel A: Acquisitions over 1993-1997							
	High-tech Acquisitions				**Low-tech Acquisitions**			
	Mean	**Median**	**Min**	**Max**	**Mean**	**Median**	**Min**	**Max**
3 points	34.83	10	0	100	18.72	0	0	100
2 points	8.06	0	0	100	3.75	0	0	100
1 point	49.10	50	0	100	72.51	100	0	100
-1 point	2.74	0	0	100	2.36	0	0	100
-2 point	5.18	0	0	100	2.65	0	0	100
0 point	52 out of 124 acquisitions have 0 points				63 out of 161 acquisitions have 0 points			
Total coded articles	211				280			
Total read articles	2277				3688			
	Panel B: Acquisitions over 1998-2000							
3 points	28.01	0	0	100	21.34	0	0	100
2 points	13.46	0	0	100	3.78	0	0	50
1 point	47.07	41.43	0	100	69.64	100	0	100
-1 point	6.14	0	0	100	4.17	0	0	100
-2 point	5.25	0	0	100	1.17	0	0	42.86
0 point	55 out of 165 acquisitions have 0 points				61 out of 128 acquisitions have 0 points			
Total coded articles	581				215			
Total read articles	4541				3547			

Table 7A-3: Regressions of acquisition risk with an alternative wealth measure

This table reports the regression results of acquisition risk over 1998-2000. It distinguishes from the Table 7-7 to Table 7-10 in that WEALTH is measured as the sum of fixed compensation, annual bonuses, and managerial shareholdings in £million. Panel A reports the results for the logistics regression whose dependent variable is target high-tech industry status. Refer to Table 7-7 to Table 7-10 for variable definitions. N = number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are Wald statistics for logistic regressions and t statistics for OLS regressions. The t-statistics in model 1 are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Panel A: Acquisitions over 1993-1997			*Panel B: Acquisitions over 1998-2000*		
	Logistic regression		**OLS regression**	**Logistic regression**		**OLS regression**
	Coefficients	**Odds**		**Coefficients**	**Odds**	
Intercept	1.57(4.29)[b]		3.63(3.69)[a]	0.38(0.25)		2.62(3.37)[a]
FAB	-0.35(1.10)	0.71	-0.27(-0.69)	-0.35(4.58)[b]	0.71	-0.12(-1.15)
LTIP CASH	-3.64(0.27)	0.03	-4.94(-0.77)	-0.11(0.01)	0.89	-0.02(-0.02)
DELTA	0.95(0.23)	2.60	6.19(2.54)[a]	0.09(0.02)	1.01	1.10(2.32)[b]
DELTA *WEALTH	-0.02(0.94)	0.98	-0.07(-2.66)[a]	-0.00(1.95)	1.00	-0.002(-2.65)[a]
VEGA				-0.77(0.16)	0.47	-0.14(-0.09)
VEGA *WEALTH				0.05(2.68)[c]	1.05	-0.00(-0.30)
PAST	-0.00(0.02)	1.00	-0.00(-0.81)	0.004(6.38)[a]	1.00	0.003(2.74)[a]
BEME	-0.02(13.32)[a]	0.98	-0.01(-2.19)[b]	-0.01(5.57)[b]	1.00	-0.01(-1.55)
MEDIA	0.13(1.02)	1.14	-0.18(-1.10)	0.28(3.91)[b]	1.32	-0.07(-0.52)
LARSHR	-0.01(2.63)	0.99	-0.01(-0.73)	-0.00(0.00)	1.00	0.01(1.03)
NEXE	-0.01(1.26)	0.99	-0.01(-1.11)	-0.00(0.00)	1.00	-0.00(-0.00)
NONDUAL	0.11(0.57)	1.26	0.57(1.50)	-0.16(0.83)	0.72	-0.25(-0.77)
REM	0.19(0.83)	1.47	0.17(0.34)	-0.51(2.35)	0.36	-0.38(-0.64)
LEV	0.00(0.20)	1.00	0.01(1.29)	-0.00(0.27)	1.00	0.01(1.45)
MV	-0.11(0.68)	0.89	0.03(0.20)	0.21(2.88)[c]	1.22	0.12(1.13)
RELSIZ	-0.02(0.07)	0.98	-0.14(-1.23)	-0.05(0.38)	0.95	-0.14(-1.73)
N	285		285	293		293
Log likelihood	34.35[a]			58.44[a]		
Pseudo -R^2	11.35%			18.08%		
F statistics			1.87[b]			2.40[a]
Adjusted R^2			4.12%			7.13%

Table 7A-4: Logistic regressions of target high-tech status over 1993-1997 with a breakdown of equity delta

This table reports the results for the regressions of acquisitions risk over 1993-1997. It is the same as Table 7-7 except that it reports the results for LTIP delta, share delta (as highlighted in the table) rather than equity delta as a whole. The squared term of the delta for LTIP shares is dropped from the models because it is seriously correlated with the delta for LTIP shares (LTIP DELTA). The VIF ratio, 52, is far above the cut off point, 10. LTIP DELTA= delta value of LTIP shares in £million. LTIP DELTA*WEALTH = the interaction of LTIP DELTA and wealth. Wealth is the sum of fixed compensation and annual bonuses, LTIP cash, LTIP shares and managerial shareholdings in £million. SHARE DELTA= delta value of managerial shareholdings in £million. SHARE DELTA^2 = the squared term of the delta for managerial shareholdings. SHARE DELTA*WEALTH = the interaction term of SHARE DELTA and wealth. The rest variable definitions can be found in Table 7-7. N = Number of acquisitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are Wald statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	1.78(5.65)^b		1.60(4.43)^b		1.58(4.30)^b	
FAB	-0.40(1.42)	0.67	-0.42(1.48)	0.66	-0.43(1.53)	0.65
LTIP CASH	-3.84(0.28)	0.02	-4.62(0.37)	0.01	-4.35(0.34)	0.01
LTIP DELTA	0.12(0.56)	1.13	0.15(0.79)	1.16	-0.09 (0.11)	0.91
LTIP DELTA *WEALTH					0.01(1.31)	1.00
SHARE DELTA	-0.00(1.43)	1.00	0.00(0.26)	1.00	0.00(0.51)	1.00
SHARE DELTA^2			-0.00(1.19)	1.00		
SHARE DELTA *WEALTH					-0.00(1.91))	0.98
PAST	-0.00(0.01)	1.00	-0.00(0.03)	1.00	-0.00(0.04)	1.00
BEME	-0.02(14.70)^a	0.98	-0.02(13.85)^a	0.98	-0.02(13.43)^a	0.98
MEDIA	0.12(0.87)	1.13	0.13(0.92)	1.10	0.11(0.73)	1.12
LARSHR	-0.01(2.80)^c	0.99	-0.01(2.26)	0.99	-0.01(2.38)	0.99
NEXE	-0.01(1.65)	0.99	-0.01(1.43)	0.99	-0.01(1.31)	0.99
NONDUAL	0.11(0.48)	1.23	0.12(0.58)	1.26	0.13(0.67)	1.29
REM	0.18(0.76)	1.44	0.19(0.80)	1.46	0.19(0.77)	1.45
LEV	0.00(0.23)	1.00	0.00(0.24)	1.00	0.00(0.22)	1.00
MV	-0.10(0.56)	0.90	-0.11(0.59)	0.90	-0.10(0.55)	0.90
RELSIZ	-0.02(0.07)	0.98	-0.03(0.09)	0.97	-0.03(0.08)	0.97
N	285		285		285	
Log likelihood	33.92^a		35.16^a		36.58^a	
Pseudo-R^2	11.22%		11.61%		12.05%	

Table 7A-5: OLS regressions of target industrial R&D intensity over 1993-1997 with a breakdown of equity delta

This table reports the results for the regressions of acquisitions risk over 1993-1997. It is the same as Table 7-8 except that it reports the results for LTIP delta, share delta (as highlighted in the table) rather than equity delta as a whole. The squared term of the delta for LTIP shares is dropped from the models because it is seriously correlated with the delta for LTIP shares (LTIP DELTA). The VIF ratio, 52, is far above the cut off point, 10. LTIPCASH = LTIP cash award in £million. LTIP DELTA= delta value of LTIP shares in £million. LTIP DELTA*WEALTH = the interaction of LTIP DELTA and wealth. Wealth is the sum of fixed compensation and annual bonuses, LTIP cash, LTIP shares and managerial shareholdings in £million. SHARE DELTA= delta value of managerial shareholdings in £million. SHARE DELTA^2 = the squared term of the delta for managerial shareholdings. SHARE DELTA*WEALTH = the interaction term of SHARE DELTA and wealth. Refer to Table 7-8 for the rest of the variable definitions. N = Number of acquisitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are t statistics. The t-statistics in Model 1 are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	4.18(4.65) [a]	3.66(3.71) [a]	3.65(3.70) [a]
FAB	-0.36 (-0.75)	-0.31(-0.78)	-0.30(-0.75)
LTIP CASH	-3.49(-1.03)	-4.98(-0.78)	-5.01(-0.78)
LTIP DELTA	0.05(0.25)	0.08(0.44)	0.04(0.12)
LTIP DELTA *WEALTH			-0.00(-0.53)
SHARE DELTA	0.00(0.16)	0.01(2.53) [a]	0.00(2.58) [a]
SHARE DELTA^2		-0.00(-2.69) [a]	
SHARE DELTA *WEALTH			-0.00(-2.70) [a]
PAST	-0.00(-0.60)	-0.00(-0.81)	-0.00(-0.83)
BEME	-0.01(-2.38) [b]	-0.01(-2.23) [b]	-0.01(-2.18) [b]
MEDIA	-0.19(-1.28)	-0.19 (-1.13)	-0.19(-1.17)
LARSHR	-0.01(-1.01)	-0.01(-0.68)	-0.01(-0.70)
NEXE	-0.01(-1.22)	-0.01(-1.14)	-0.01(-1.12)
NONDUAL	0.52(1.38)	0.57(1.49)	0.58(1.51)
REM	0.15(0.33)	0.17(0.33)	0.16(0.32)
LEV	0.01(1.44)	0.01(1.30)	0.01(1.28)
MV	0.06(0.23)	0.04(0.22)	0.04(0.23)
RELSIZ	-0.13(-0.96)	-0.12(-1.25)	-0.15(-1.26)
N	285	285	285
F statistics	1.34	1.76 [b]	1.66 [b]
Adjusted R^2	1.64%	3.87%	3.60%

Table 7A-6: Logistic regressions of target high-tech status over 1998-2000 with a breakdown of equity delta

This table reports the results for the regressions of acquisitions risk over 1998-2000. It is the same as Table 7-9 except that it reports the results for LTIP delta, option delta, share delta (as highlighted in the table) rather than equity delta as a whole. The squared term of the delta for LTIP shares, option vega (VEGA) and the interaction of option vega and wealth (VEGA*WEALTH) are dropped from the models because the squared term of the delta for LTIP shares is seriously correlated with the delta for LTIP shares (LTIP DELTA); option vega (VEGA) and the interaction of vega and wealth (VEGA*WEALTH) are both seriously correlated with option delta (OPTION DELTA) and the interaction of option delta and wealth (OPTION DELTA*WEALTH). The VIF ratio for the squared term of LTIP delta is 15 and for the VEGA and VEGA*WEALTH is all above 50. OPTION DELTA = delta value of stock options in £million. OPTION DELTA^2 = the squared term of option delta. OPTION DELTA*WEALTH = the interaction of option delta and wealth. Wealth is the sum of fixed compensation and annual bonuses, LTIP cash, LTIP shares, stock options, and managerial shareholdings in £million. See Table 7A-5 for definitions of LTIP DELTA, LTIP DELTA*WEALTH, SHARE DELTA, SHARE DELTA^2, SHARE DELTA*WEALTH. Refer to Table 7-9 for the rest of variable definitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are Wald statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	0.26(0.12)		0.14(0.03)		0.01(0.02)	
FAB	-0.24(2.97)^c	0.79	-0.24(3.00)^c	0.79	-0.31(3.61)^b	0.73
LTIP CASH	-0.32(0.09)	0.73	-0.09(0.00)	0.92	0.19(0.03)	1.21
LTIP DELTA	-0.02 (4.05)^b	0.98	-0.02(4.25)^b	0.98	-0.02(1.55)	0.98
LTIP DELTA *WEALTH					0.00(0.22)	1.00
OPTION DELTA	0.00(0.46)	1.00	0.01(0.33)	1.00	-0.01(0.71)	1.00
OPTION DELTA^2			-0.00(0.13)	1.00		
OPTION DELTA *WEALTH					0.00(2.31)	1.00
SHARE DELTA	-0.00(0.33)	1.00	0.00(1.50)	1.00	0.00(0.28)	1.00
SHARE DELTA^2			-0.00(2.16)	1.00		
SHARE DELTA *WEALTH					-0.00(2.45)	1.00
PAST	0.004(6.66)^a	1.00	0.04(6.10)^a	1.00	0.004(6.29)^a	1.00
BEME	-0.01(6.44)^a	0.99	-0.01(5.48)^b	0.99	-0.01(5.35)^b	0.99
MEDIA	0.30(4.60)^b	1.35	0.29(4.24)^b	1.34	0.31(4.80)^b	1.37
LARSHR	-0.00(0.31)	1.00	-0.00(0.03)	1.00	-0.00(0.02)	1.00
NEXE	0.00(0.01)	1.00	0.00(0.03)	1.00	0.00(0.05)	1.00
NONDUAL	-0.16(0.85)	0.72	-0.17(0.89)	0.71	-0.17(0.85)	0.72
REM	-0.47(2.03)	0.39	-0.52(2.45)^c	0.36	-0.53(2.56)^c	0.35
LEV	-0.00(0.00)	1.00	-0.00(0.01)	1.00	-0.00(0.07)	1.00
MV	0.18(2.62)	1.20	0.16(2.06)	1.18	0.21(3.00)^c	1.24
RELSIZ	-0.04(0.19)	0.96	-0.04(0.22)	0.96	-0.03(0.14)	0.97
N	293		293		293	
Log likelihood	57.59^a		60.27^a		63.00^a	
Pseudo -R^2	17.84%		18.59%		19.35%	

Table 7A-7: OLS regressions of target industrial R&D intensity over 1998-2000 with a breakdown of equity delta

This table reports the results for the regressions of acquisitions risk over 1998-2000. It is the same as Table 7-10 except that it reports the results for LTIP delta, share delta (as highlighted in the table) rather than equity delta as a whole. The squared term of the delta for LTIP shares, option vega (VEGA) and the interaction of option vega and wealth (VEGA*WEALTH) are dropped from the models because the squared term of the delta for LTIP shares is seriously correlated with the delta for LTIP shares (LTIP DELTA); option vega (VEGA) and the interaction of vega and wealth (VEGA*WEALTH) are both seriously correlated with option delta (OPTION DELTA) and the interaction of option delta and wealth (OPTION DELTA*WEALTH). The VIF ratio for the squared term of LTIP delta is 15 and for the VEGA and VEGA*WEALTH is all above 50. All of these ratios are far above the cut off point, 10. OPTION DELTA = delta value of stock options in £million. OPTION DELTA^2 = the squared term of option delta. OPTION DELTA*WEALTH = the interaction of option delta and wealth. Wealth is the sum of fixed compensation and annual bonuses, LTIP cash, LTIP shares, stock options, and managerial shareholdings in £million. See Table 7A-5 for definitions of LTIP DELTA, LTIP DELTA*WEALTH, SHARE DELTA, SHARE DELTA^2, SHARE DELTA*WEALTH. Refer to Table 7-10 for the rest of variable definitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are t statistics. The t-statistics in the three models are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	2.44(2.60)[a]	2.41(2.57)[a]	2.39(2.58)[a]
FAB	-0.10(-1.09)	-0.09(-1.14)	-0.10(-1.24)
LTIP CASH	-0.22(-0.28)	0.20(0.26)	0.30(0.41)
LTIP DELTA	-0.02(-2.32)[b]	-0..02(-2.27)[b]	-0.02(-2.61)[a]
LTIP DELTA *WEALTH			0.00(1.08)
OPTION DELTA	0.00(0.40)	0.00(0.53)	0.00(0.60)
OPTION DELTA^2		-0.00(-0.45)	
OPTION DELTA *WEALTH			-0.00(-1.08)
SHARE DELTA	-0.00(-0.14)	0.00(2.66)[a]	0.001(2.71)[a]
SHARE DELTA^2		-0.00(-3.15)[a]	
SHARE DELTA *WEALTH			-0.00(-3.51)[a]
PAST	0.003(2.38)[b]	0.002(2.13)[b]	0.002(2.30)[b]
BEME	-0.01(-1.69)[C]	-0.01(-1.46)	-0.01(-1.43)
MEDIA	-0.02(-0.19)	-0.05(-0.44)	-0.05(-0.43)
LARSHR	0.00(0.27)	0.01(0.89)	0.01(1.00)
NEXE	0.00(0.09)	0.00(0.21)	0.00(0.19)
NONDUAL	-0.25(-0.79)	-0.27(-0.86)	-0.28(-0.89)
REM	-0.25(-0.46)	-0.41 (-0.78)	-0.43 (-0.82)
LEV	0.01(1.45)	0.01(1.36)	0.01(1.31)
MV	0.16(1.65)[c]	0.12(1.24)	0.12(1.24)
RELSIZ	-0.13(-1.39)	-0.13(-1.37)	-0.12(-1.34)
N	293	293	293
F Statistics	1.41[a]	2.57[a]	2.53[a]
Adjusted R^2	2.19%	8.35%	8.62%

Table 7A-8: Logistic regressions of target high-tech status over 1993-1997 with an alternative measure for managerial shareholdings

This table reports the results for the regressions of acquisitions risk over 1993-1997. It is the same as Table 7-7 except that it reports the results for LTIP delta and % of shares held by acquirer directors (as highlighted in the table) rather than equity delta. The squared term of the delta for LTIP shares is dropped from the models because it is seriously correlated with the delta for LTIP shares (LTIP DELTA). The VIF ratio, 52, is far above the cut off point, 10. MANSHR = % of shares, beneficial and non-beneficial, held by board of directors prior to acquisition announcement. $MANSHR^2$ = the squared term of the % of MANSHR. MANSHR*WEALTH = the interaction of MANSHR and wealth. Refer to Table 7A-4 for the variable definition of WEALTH, LTIP DELTA, LTIP DELTA*WEALTH. Refer to Table 7-7 for the rest of the variable definition. N = Number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are Wald statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	2.07(5.35)[b]		1.47(2.33)		1.41(2.24)	
FAB	-0.38(1.24)	0.68	-0.39(1.25)	0.68	-0.53(2.25)	0.59
LTIP CASH	-3.40(0.22)	0.03	-3.24(0.20)	0.04	-3.65(0.26)	0.03
LTIP DELTA	0.07(0.21)	1.08	0.06(0.15)	1.06	-0.00 (0.00)	1.00
LTIP DELTA *WEALTH					0.00(0.16)	1.00
MANSHR	-0.01(0.67)	0.99	0.03(1.73)	1.03	0.01(1.06)	1.00
$MANSHR^2$			-0.00(3.01)[c]	1.00		
MANSHR *WEALTH					-0.00(4.26)[b]	1.00
PAST	-0.00(0.00)	1.00	0.00(0.00)	1.00	-0.00(0.02)	1.00
BEME	-0.02(14.14)[a]	0.98	-0.02(12.88)[a]	0.98	-0.02(15.38)[a]	0.98
MEDIA	0.13(0.94)	1.14	0.12(0.85)	1.13	0.11(0.61)	1.11
LARSHR	-0.01(2.69)[c]	0.99	-0.01(2.26)	0.99	-0.01(2.03)	0.99
NEXE	-0.01(1.27)	0.99	-0.01(0.81)	1.00	-0.01(1.78)	0.99
NONDUAL	0.09(0.33)	1.19	0.08(0.26)	1.17	0.13(0.69)	1.29
REM	0.16(0.61)	1.39	0.18(0.69)	1.42	0.22(1.09)	1.56
LEV	0.00(0.18)	1.00	0.00(0.18)	1.00	0.00(0.25)	1.00
MV	-0.18(1.49)	0.84	-0.12(0.70)	0.88	-0.10(0.03)	0.97
RELSIZ	-0.03(0.09)	0.97	-0.03(0.08)	0.97	-0.03(0.09)	0.97
N	285		285		285	
Log likelihood	33.11[a]		36.28[a]		38.57[a]	
Pseudo-R^2	10.97%		11.95%		12.66%	

Table 7A-9: OLS regressions of target industrial R&D intensity over 1993-1997 with an alternative measure for managerial shareholdings

This table reports the results for the regressions of acquisitions risk over 1993-1997. It is the same as Table 7-8 except that it reports the results for LTIP delta, % of shares held by acquirer directors (as highlighted in the table) rather than equity delta. The squared term of the delta for LTIP shares is dropped from the models because it is seriously correlated with the delta for LTIP shares (LTIP DELTA). The VIF ratio, 52, is far above the cut off point, 10. MANSHR = % of shares, beneficial and non-beneficial, held by board of directors prior to acquisition announcement. $MANSHR^2$ = the squared term of the % of MANSHR. MANSHR*WEALTH = the interaction of MANSHR and wealth. Refer to Table 7A-5 for the definitions of WEALTH, LTIP DELTA, LTIP DELTA*WEALTH. Refer to Table 7-8 for the rest of the variable definitions. N = Number of acquisitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are t statistics. The t-statistics in model 1 are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

.	Model 1	Model 2	Model 3
Intercept	4.29(3.69) ^{a}	3.02(2.43) ^{b}	3.78(3.04) ^{a}
FAB	-0.37 (-0.91)	-0.37(-0.93)	-0.45(-1.10)
LTIP CASH	-3.58(-0.55)	-3.65(-0.57)	-3.88(-0.60)
LTIP DELTA	0.06(0.32)	0.03(0.18)	0.14(0.44)
LTIP DELTA *WEALTH			-0.00(-0.29)
MANSHR	-0.00(-0.15)	0.08(2.42) ^{b}	0.01(0.68)
$MANSHR^2$		-0.00(-2.68) ^{a}	
MANSHR *WEALTH			-0.00(-1.12)
PAST	-0.00(-0.55)	-0.00(-0.47)	-0.00(-0.58)
BEME	-0.01(-2.54) ^{a}	-0.01(-2.25) ^{b}	-0.01(-2.63) ^{b}
MEDIA	-0.20(-1.18)	-0.21 (-1.27)	-0.21(-1.22)
LARSHR	-0.01(-1.02)	-0.01(-0.72)	-0.01(-0.87)
NEXE	-0.02(-1.40)	-0.01(-1.12)	-0.02(-1.50)
NONDUAL	0.52(1.36)	0.50(1.31)	0.57(1.48)
REM	0.14(0.26)	0.21(0.40)	0.21(0.39)
LEV	0.01(1.34)	0.01(1.39)	0.01(1.40)
MV	0.05(0.29)	0.16(0.89)	0.14(0.73)
RELSIZ	-0.13(-1.11)	-0.13(-1.13)	-0.13(-1.12)
N	285	285	285
F statistics	1.34	1.76 ^{b}	1.25
Adjusted R^2	1.64%	3.84%	1.41%

Table 7A-10: Logistic regressions of target high-tech status over 1998-2000 with an alternative measure for managerial shareholdings

This table reports the results for the regressions of acquisitions risk over 1998-2000. It is the same as Table 7-9 except that it reports the results for LTIP delta, Option delta, and % of shares held by acquirer directors (as highlighted in the table) rather than equity delta. The squared term of the delta for LTIP shares, option vega (VEGA) and the interaction of option vega and wealth (VEGA*WEALTH) are dropped from the models because the squared term of the delta for LTIP shares is seriously correlated with the delta for LTIP shares (LTIP DELTA): option vega (VEGA) and the interaction of vega and wealth (VEGA*WEALTH) are both seriously correlated with option delta (OPTION DELTA) and the interaction of option delta and wealth (OPTION DELTA*WEALTH). The VIF ratio for the squared term of LTIP delta is 15 and for the VEGA and VEGA*WEALTH is all above 50. MANSHR = % of shares, beneficial and non-beneficial, held by board of directors prior to acquisition announcement. $MANSHR^2$ = the squared term of the % of MANSHR. MANSHR*WEALTH = the interaction of MANSHR and wealth. Refer to Table 7A-6 for the definitions of WEALTH, LTIP DELTA, LTIP DELTA*WEALTH, OPTION DELTA, OPTION $DELTA^2$, OPTION DELTA*WEALTH. See Table 7-9 for the rest of the variable definitions. N = Number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are Wald statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	0.69(0.62)		0.56(0.37)		0.65(0.49)	
FAB	-0.25(3.17)[c]	0.78	-0.24(3.09)[c]	0.79	-0.27(3.56)[b]	0.77
LTIP CASH	-0.32(0.10)	0.72	-0.37(0.13)	0.69	-0.23(0.05)	0.80
LTIP DELTA	-0.02 (4.43)[b]	0.98	-0.02(4.39)[b]	0.98	-0.02(2.50)	0.98
LTIP DELTA *WEALTH					-0.00(0.09)	1.00
OPTION DELTA	0.00(0.40)	1.00	0.01(0.35)	1.00	-0.00(0.01)	1.00
OPTION $DELTA^2$			-0.00(0.15)	1.00		
OPTION DELTA *WEALTH					0.00(0.88)	1.00
MANSHR	-0.01(0.79)	1.00	0.00(0.01)	1.00	-0.01(0.28)	1.00
$MANSHR^2$			-0.00(0.20)	1.00		
MANSHR *WEALTH					-0.01(0.59)	1.00
PAST	0.004(6.83)[a]	1.00	0.004(6.53)[a]	1.00	0.004(6.53)[a]	1.00
BEME	-0.01(6.75)[a]	0.99	-0.01(6.16)[a]	0.99	-0.01(6.94)[a]	0.99
MEDIA	0.31(4.67)[b]	1.36	0.31(4.09)[b]	1.36	0.31(4.80)[b]	1.37
LARSHR	-0.01(0.81)	0.99	-0.01(0.93)	0.99	-0.01(0.84)	0.99
NEXE	0.00(0.04)	1.00	0.00(0.10)	1.00	0.00(0.09)	1.00
NONDUAL	-0.16(0.86)	0.72	-0.15(0.74)	0.73	-0.15(0.69)	0.74
REM	-0.50(2.22)	0.37	-0.54(2.37)	0.34	-0.48(1.98)	0.39
LEV	-0.00(0.0)	1.00	0.00(0.00)	1.00	0.00(0.01)	1.00
MV	0.13(1.22)	1.14	0.13(1.26)	1.14	0.13(1.15)	1.14
RELSIZ	-0.03(0.16)	0.97	-0.04(0.20)	0.96	-0.03(0.12)	0.97
N	293		293		293	
Log likelihood	58.05[a]		58.40[a]		59.27[a]	
Pseudo -R^2	17.97%		18.07%		18.31%	

Table 7A-11: OLS regressions of target industrial R&D intensity over 1998-2000 with an alternative measure for managerial shareholdings

This table reports the results for the regressions of acquisitions risk over 1998-2000. It differs from Table 7-10 in that it reports the results for LTIP delta, % of shares held by acquirer directors (as highlighted in the table) rather than equity delta. The squared term of the delta for LTIP shares, option vega (VEGA) and the interaction of option vega and wealth (VEGA*WEALTH) are dropped from the models because the squared term of the delta for LTIP shares is seriously correlated with the delta for LTIP shares (LTIP DELTA); option vega (VEGA) and the interaction of vega and wealth (VEGA*WEALTH) are both seriously correlated with option delta (OPTION DELTA) and the interaction of option delta and wealth (OPTION DELTA*WEALTH). The VIF ratio for the squared term of LTIP delta is 15 and for the VEGA and VEGA*WEALTH is all above 50. MANSHR = % of shares, beneficial and non-beneficial, held by board of directors prior to acquisition announcement. $MANSHR^2$ = the squared term of the % of MANSHR. MANSHR*WEALTH = the interaction of MANSHR and wealth. Refer to Table 7A-6 for the definitions of WEALTH, LTIP DELTA, LTIP DELTA*WEALTH, OPTION DELTA, OPTION $DELTA^2$, OPTION DELTA*WEALTH. Refer to Table 7-10 for the rest of the variable definitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are White (1980)-adjusted t statistics for heteroscedasticity. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	2.58(2.88)[a]	2.48(2.70)[a]	2.65(2.79)[a]
FAB	-0.11(-0.95)	-0.10(-0.93)	-0.11(-0.97)
LTIP CASH	-0.22(-0.23)	-0.25(-0.26)	-0.28(-0.30)
LTIP DELTA	-0.02(-1.77)[c]	-0.02(-1.78)[c]	-0.02(-1.71)[c]
LTIP DELTA *WEALTH			0.00(0.31)
OPTION DELTA	0.00(0.54)	0.00(0.52)	0.00(0.96)
OPTION DELTA ^{2}		-0.00(-0.34)	
OPTION DELTA *WEALTH			-0.00(-0.95)
MANSHR	-0.00(-0.31)	0.01(0.26)	-0.01(-0.48)
MANSHR ^{2}		-0.00(-0.40)	
MANSHR *WEALTH			0.00(0.53)
PAST	0.003(2.81)[a]	0.003(2.77)[a]	0.003(2.90)[a]
BEME	-0.01(-1.71)[c]	-0.01(-1.56)	-0.01(-1.61)
MEDIA	-0.04(-0.17)	-0.02(-0.15)	-0.02(-0.15)
LARSHR	0.00(0.13)	0.00(0.08)	0.00(0.08)
NEXE	0.00(0.14)	0.00(0.23)	0.00(0.15)
NONDUAL	-0.25(-0.77)	-0.24(-0.72)	-0.26(-0.80)
REM	-0.26(-0.44)	-0.31 (-0.51)	-0.30 (-0.49)
LEV	0.01(1.84)	0.01(1.83)	0.01(1.85)
MV	0.14(1.33)	0.15(1.33)	0.13(1.16)
RELSIZ	-0.13(-1.57)	-0.13(-1.59)	-0.13(-1.53)
N	293	293	293
F Statistics	2.29[a]	2.02[a]	1.95[a]
Adjusted R^2	6.21%	5.62%	5.5%

Table 7A-12: Logistic regressions of target high-tech status over 1993-1997 with deflated wealth variables

This table differs from Table 7-7 in that all the wealth variables defined in Table 7-7 are deflated by acquirers' total assets in the accounting year prior to acquisition. N = number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are t statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	1.71(3.45) [b]		1.59(2.75) [c]		1.56(2.66) [c]	
FAB	0.02(0.04)	1.02	0.03(0.11)	1.03	0.03(0.14)	1.03
LTIP CASH	-20.61(0.25)	0.00	-20.12(0.24)	0.00	-20.00(0.24)	0.00
DELTA	0.05(0.02)	1.05	0.32(0.20)	1.38	0.38(0.28)	1.46
DELTA^2			-0.14(0.20)	0.87		
DELTA*WEALTH					-0.00(0.29)	0.98
PAST	-0.00(0.00)	1.00	-0.00(0.00)	1.00	-0.00(0.00)	1.00
BEME	-0.02(12.18) [a]	0.99	-0.02(11.36) [a]	0.98	-0.02(11.25) [a]	0.98
MEDIA	0.12(0.85)	1.13	0.13(0.94)	1.14	0.13(0.97)	1.14
LARSHR	-0.01(2.16)	0.99	-0.01(2.02)	0.99	-0.01(2.01)	0.99
NEXE	-0.01(0.57)	0.99	-0.01(0.47)	0.99	-0.01(0.46)	0.99
NONDUAL	0.07(0.22)	1.15	0.07(0.20)	1.14	0.07(0.20)	1.14
REM	0.18(0.73)	1.45	0.18(0.67)	1.42	0.17(0.65)	1.42
LEV	0.00(0.05)	1.00	0.00(0.02)	1.00	0.00(0.02)	1.00
MV	-0.23(4.35) [b]	0.80	-0.21(3.67) [c]	0.81	-0.21(3.57) [c]	0.81
RELSIZ	-0.02(0.05)	0.98	-0.02(0.06)	0.98	-0.02(0.07)	0.98
N	285		285		285	
Log likelihood	31.04 [a]		31.24 [a]		31.33 [a]	
Pseudo-R^2	10.32%		10.38%		10.41%	

Table 7A-13: OLS regressions of target industrial R&D intensity over 1993-1997 with deflated wealth variables

This table differs from Table 7-8 in that all the wealth variables defined in Table 7-8 are deflated by acquirers' total assets in the accounting year prior to acquisition announcement. N = number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are t statistics. The t-statistics in model 1 are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	3.79(3.11)[a]	3.42(2.71)[a]	3.41(2.70)[a]
FAB	-0.03 (-0.29)	0.01(0.10)	0.02(0.15)
LTIP CASH	-12.62(-0.30)	-11.44(-0.28)	-11.37(-0.27)
DELTA	0.52(-1.10)	1.45(1.57)	1.49(1.61)
DELTA^2		-0.48(-1.17)	
DELTA*WEALTH			-0.00(-1.22)
PAST	-0.00(-0.72)	-0.00(-0.78)	-0.00(-0.78)
BEM	-0.02(-2.16)[b]	-0.01(-1.90)[c]	-0.01(-1.89)[c]
MEDIA	-0.21(-1.22)	-0.18(-1.05)	-0.18(-1.04)
LARSHR	-0.01(-0.64)	-0.01(-0.51)	-0.01(-0.52)
NEXE	-0.01(-1.23)	-0.01(-1.06)	-0.01(-1.05)
NONDUAL	0.52(1.36)	0.50(1.29)	0.50(1.29)
REM	0.24(0.46)	0.18(0.35)	0.18(0.34)
LEV	0.01(1.44)	0.01(1.25)	0.01(1.24)
MV	0.02(0.14)	0.02(0.17)	0.03(0.19)
RELSIZ	-0.12(-1.06)	-0.13(-1.13)	-0.13(-1.14)
N	285	285	285
F statistics	1.44	1.44	1.45
Adjusted R^2	1.98%	2.11%	2.16%

Table 7A-14: Logistic regressions of target high-tech status over 1998-2000 with deflated wealth variables

This table differs from Table 7-9 in that all the wealth variables defined in Table 7-9 are deflated by acquirers' total assets in the accounting year prior to acquisition announcement. N = number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are Wald statistics a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1		Model 2		Model 3	
	Coefficients	**Odds**	**Coefficients**	**Odds**	**Coefficients**	**Odds**
Intercept	0.80(0.89)		0.69(0.65)		0.57(0.43)	
FAB	-0.05(0.60)	0.95	-0.06(0.89)	0.94	-0.07(1.11)	0.93
LTIP CASH	0.18(0.04)	1.20	0.22(0.05)	1.24	0.21(0.05)	1.24
DELTA	0.12(1.45)	1.13	0.34(2.05)	1.41	0.16(0.34)	1.17
DELTA^2			-0.04(1.14)	0.98		
DELTA*WEALTH					0.00(0.53)	1.00
VEGA	0.25(0.11)	1.29	0.20 (0.06)	1.22	2.24(2.76)^c	9.43
VEGA*WEALTH					-0.01(3.00)^c	1.00
PAST	0.004(5.53)^b	1.00	0.004(4.78)^b	1.00	0.004(4.04)^b	1.00
BEME	-0.01(8.35)^a	0.99	-0.01(7.92)^a	0.99	-0.01(7.58)^a	0.99
MEDIA	0.22(2.68)^c	1.25	0.23(2.84)^c	1.26	0.23(2.77)^c	1.26
LARSHR	-0.00(0.01)	1.00	-0.00(0.0)	1.00	0.00(0.03)	1.00
NEXE	0.00(0.03)	1.00	-0.00(0.03)	1.00	0.00(0.02)	1.00
NONDUAL	-0.14(0.64)	0.76	-0.14(0.64)	0.75	-0.16(0.81)	0.73
REM	-0.46(1.84)	0.40	-0.44(1.69)	0.42	-0.32(0.81)	0.53
LEV	-0.00(0.14)	1.00	-0.00(0.17)	1.00	-0.00(0.14)	1.00
MV	0.04(0.14)	1.04	0.04(0.17)	1.00	0.04(0.21)	1.05
RELSIZ	-0.06(0.55)	0.94	-0.06(0.57)	0.94	-0.08(0.79)	0.93
N	293		293		293	
Log likelihood	49.06^a		50.11^a		56.04^a	
Pseudo -R^2	15.42%		15.72%		17.41%	

Table 7A-15: OLS regressions of target industrial R&D intensity over 1998-2000 with deflated wealth variables

This table differs from Table 7-10 in that all the wealth variables defined in Table 7-10 are deflated by acquirers' total assets in the accounting year prior to acquisition announcement. N = number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. The t-statistics in all the three models are corrected by the White (1980) heteroscedasticity procedure. In parentheses are Wald statistics. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	2.85(2.74)[a]	2.73(2.57)[a]	2.50(2.37)[b]
FAB	-0.06(-1.12)	-0.07(-1.34)	-0.07(-1.25)
LTIP CASH	0.06(0.12)	0.09(0.19)	0.10(0.21)
DELTA	0.09(1.63)[c]	0.29(1.39)	0.23(1.16)
$DELTA^2$		-0.01(-1.15)	
DELTA*WEALTH			-0.00(-0.14)
VEGA	0.21(0.40)	0.15(0.29)	1.16(1.49)
VEGA*WEALTH			-0.00(-2.31)[b]
PAST	0.002(2.16)[b]	0.002(1.66)[c]	0.002(1.52)
BEME	-0.01(-1.92)[c]	-0.01(-1.86)[b]	-0.01(-1.78)[c]
MEDIA	-0.06(-0.50)	-0.05(-0.44)	-0.06(-0.47)
LARSHR	0.01(0.77)	0.01(0.93)	0.01(0.93)
NEXE	0.00(0.05)	0.00(0.09)	0.00(0.07)
NONDUAL	-0.20(-0.61)	-2.21(-0.64)	-0.24(-0.74)
REM	-0.36(-0.63)	-0.32 (-0.53)	-0.19 (-0.27)
LEV	0.01(1.27)	0.01(1.21)	0.01(1.23)
MV	0.08(0.92)	0.09(0.94)	0.10(1.05)
RELSIZ	-0.14(-1.57)	-0.14(-1.54)	-0.14(-1.62)
N	293	293	293
F Statistics	2.21[a]	2.15[a]	2.21[a]
Adjusted R^2	5.50%	5.60%	6.24%

Table 7A-16: Regressions on acquisition risk with institutional shareholdings

This table reports the regression results on acquisition risk. It distinguishes from the Table 7-7 to Table 7-10 in that institutional blockholdings (INSTSHR) are included in the regression models rather than external blockholdings. INSTSHR = % of shares, greater than 3%, held by institutional shareholders. Panel A reports the results for the logistics regression whose dependent variable is target high-tech industry status. The dependent variable is coded as 0 if targets are in low-tech industries and 1 if in high-tech industries. N = number of acquisitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are Wald statistics for logistic regressions and t statistics for OLS regressions. The t-statistics in OLS regression over 1998-2000 are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Panel A: Acquisitions over 1993-1997			*Panel B: Acquisitions over 1998-2000*		
	Logistic regression		**OLS regression**	**Logistic regression**		**OLS regression**
	Coefficients	**Odds**		**Coefficients**	**Odds**	
Intercept	1.36(3.29)[c]		3.75(3.87)[a]	0.33(0.20)		2.63(3.37)[a]
FAB	-4.3(1.74)	0.65	-0.34(-0.88)	-0.35(4.44)[b]	0.71	-0.12(-1.16)
LTIP CASH	-3.05(0.19)	0.05	-4.76(-0.75)	-0.04(0.00)	0.96	-0.00(-0.00)
DELTA	1.32(0.46)	3.76	6.00(2.47)[a]	0.17(0.09)	1.19	1.18(2.47)[a]
DELTA *WEALTH	-0.03(1.18)	0.98	-0.07(-2.63)[a]	-0.00(2.25)	1.00	-0.002(-2.72)[a]
VEGA				-1.65(0.57)	0.19	0.09(0.05)
VEGA *WEALTH				0.05(2.58)	1.05	-0.00(-0.38)
PAST	-0.00(0.12)	1.00	-0.00(-0.93)	0.004(6.47)[a]	1.00	0.003(2.79)[a]
BEME	-0.02(12.85)[a]	0.99	-0.01(-2.14)[b]	-0.01(6.02)[a]	0.99	-0.01(-1.46)
MEDIA	0.14(1.09)	1.15	-0.19(-1.17)	0.28(4.00)[b]	1.32	-0.06(-0.50)
INSTSHR	-0.01(0.80)	1.00	-0.01(-1.22)	0.00(0.26)	1.00	0.01(0.99)
NEXE	-0.01(2.03)	0.99	-0.01(-1.22)	-0.00(0.00)	1.00	0.00(0.06)
NONDUAL	0.12(0.60)	1.27	0.59(1.54)	-0.18(0.97)	0.70	-0.25(-0.76)
REM	0.21(1.00)	1.52	0.22(0.42)	-0.55(2.89)[c]	0.33	-0.33(-0.58)
LEV	0.00(0.32)	1.00	0.01(1.27)	-0.00(0.33)	1.00	0.01(1.44)
MV	-0.08(0.40)	0.92	0.05(0.31)	0.21(3.10)[c]	1.23	0.10(0.97)
RELSIZ	-0.03(0.12)	0.97	-0.14(-1.24)	-0.06(0.40)	0.95	-0.14(-1.68)[c]
N	285		285	293		293
Log likelihood	32.47[a]			58.68[a]		
Pseudo -R^2	10.77%			18.15%		
F statistics			1.95[b]			2.44[a]
Adjusted R^2			4.46%			7.30%

Chapter 8

Acquisition Risk and Value Creation in Acquisitions

8.1 Introduction

This chapter aims to answer research question Q2 raised in Chapter 5, which is:

Q2: To what extent is firm performance related to the optimal and suboptimal risk level of an investment project?

In the case of acquisitions, the purpose of research question Q2 is to explore the association between acquirer post-acquisition performance and the optimal/suboptimal risk levels of acquisitions. Section 6.5.2 of Chapter 6 explains the optimal level of acquisition risk can be derived based on the prediction of the empirical risk model. Both logistic regression and OLS regression are used to estimate the empirical risk model (see Table 7-7 to Table 7-10 in Chapter 7). Which type of regression is used (logistic or OLS) depends on whether the measure of the dependent variable, acquisition risk, is a continuous data type or a categorical data type. The three models are then run for either the logistic or OLS regressions, with different combinations of independent variables (see Table 7-7 to Table 7-10 in Chapter 7). Out of these three models, Model 3 is the most appropriate model for predicting the optimal acquisition risk (see Section 7.4.5 of Chapter 7).

When the actual acquisition risk is more or less than the predicted acquisition risk, the acquisition is classified as a suboptimal-risk investment, i.e., as either an over-risk acquisition or an under-risk acquisition. Section 5.8 of Chapter hypothesizes that both types of suboptimal-risk acquisitions lead to negative post-acquisition performance.

To test the above hypothesis, as per Model 6-2 and Model 6-3 in Chapter 6, acquisitions are divided into three categories, i.e., under-risk, optimal-risk, or over-risk. The results are reported in Section 8.2. Section 8.3 then analyses the post-acquisition performance of acquirers in the high-tech acquisition group and the low-tech acquisition group separately in a manner corresponding to the event study methodology introduced in Section 6.5.3 of Chapter 6. The post-acquisition performance of each acquisition risk group is discussed in Section 8.4. In addition to this univariate analysis, a multiple regression analysis is also conducted to examine the association between post-acquisition performance and optimal/suboptimal acquisition risk. The results are reported in Section 8.5.

So far I have described how this chapter will report the results of the analyses to answer research question Q2, which is the second stage of the two-stage analysis of the relationship between post-acquisition performance and factors that affect managers' risk incentive. Section 8.7 of Chapter 8 reports results based on a one-stage analysis of such a relationship. The one-stage model is described in Model 6-5 in Chapter 6. The one-stage model directly examines the association between post-acquisition performance and factors that influence managers' risk incentive without considering managers' selection of acquisition risk. As discussed in Section 6.5.6 of Chapter 6, this one-stage analysis is common in the existing finance literature. The purpose of reporting the results for the one-stage analysis is to show how the two-stage analysis proposed by this thesis differs from, and is superior to the one-stage analysis. The chapter summary and a discussion of the limitations of the two-stage model are in Section 8.7.

8.2 Optimal/suboptimal- risk acquisitions

How to derive optimal/suboptimal acquisition risk is described in Section 6.5.2 of Chapter 6. Model 3 in Table 7-7 to Table 7-10 (in Chapter 7) are used to predict the optimal acquisition risk. Model 3 in Table 7-7 and Table 7-9 are logistic regressions. Lachenbruch holdout procedure is adopted in logistic regressions to estimate the probability of a sample acquisition belonging to a high-tech or low-tech acquisition (see Section 6.5.2 of Chapter 6). The acquisition is classified as a high-tech acquisition if the predicted probability of it being a high-tech acquisition is greater than 50%. Otherwise it is categorized as a low-tech acquisition. Comparing this predicted acquisition group with the actual acquisition group generates three investment categories: under-risk investment (UNDINV), optimal-risk investment (OPTINV) and over-risk investment (OVEINV) (see Mode 6-2 in Chapter 6).

Model 3 in Table 7-8 and Table 7-10 (in Chapter 7) are OLS regressions. Following Model 6-3 in Chapter 6 only generates two investment categories, under-risk investment and over-risk investment because none of the target industry R&D intensities is exactly the same as predicted. There is no optimal-risk investment group. However, to allow for the prediction errors of the OLS regressions, I consider all the acquisitions whose target industry R&D intensity is within the range of (-90%, +110%) [150] of the predicted target industry R&D intensity to be optimal-risk acquisitions, and these acquisitions are allocated to the optimal-risk investment group.

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[150] I acknowledge that these cut off points are subjective. However, they only affect the results of univariate analysis, but not multiple regression analysis because in multiple regression analysis the residuals of the OLS regressions are used rather than the three investment categories to explain the post-acquisition performance. See Model 6-4 in Chapter 6.

Thus, the OLS regressions are forced to yield three investment categories just like the logistic regressions.

Table 8-1 reports the distributions of acquisitions in the three investment categories. Panel A reports the result for the period 1993-1997 and Panel B shows the result for the period 1998-2000. When acquisition risk is proxied by target high-tech industry status, about 64% of acquisitions belong to the optimal-risk category (OPTINV) in the 1993-2000 sample period. About 16% of acquisitions are in the under-risk category (UNDINV), and 20% are in the over-risk category (OVEINV). In the 1998-2000 sample period, the proportion of acquisitions assigned to the optimal-risk group (OPTINV) is 62%, 22% are assigned to the under-risk group (UNDINV), and 16% to the over-risk group (OVEINV).

When acquisition risk is measured by target industry R&D intensity, in the 1993-1997 sample period, about 18% of acquisitions fall into the optimal-risk group (OPTINV), 49% of acquisitions are in the under-risk category (UNDINV), and 33% are in the over-risk category (OVEINV). In the 1998-2000-sample period, the proportion of acquisitions assigned to the optimal-risk group drops to 14%. Acquisitions in the under-risk group are also reduced (UNDINV), to 44%. In contrast, acquisitions in the over-risk acquisition group (OVEINV) increase to 42%. This classification shows that over-risk acquisitions increase in the period when the stock market is bullish. This corresponds to the findings reported in Chapter 7 that during the bull market of the late 1990s many acquisitions are driven by managerial risk seeking induced by overconfidence/over-optimism/hubris.

It is worth noting that the increase in over-risk acquisitions in the period 1998-2000 as compared to the period 1993-1997 is not found when acquisition risk is

Table 8-1: Sample distribution of acquisition risk groups predicted by the empirical risk model

This table reports the distribution of acquisitions classified by their risk level based on the prediction of Model3 in Table 7-7 to Table 7-10. Panel A reports the results for the sample period 1993-1997 and Panel B shows the results for the sample period 1998-2000. When acquisition risk is proxied by target high-tech industry status, UNDINV indicates under-risk acquisitions which is actual acquisition risk lower than the predicted acquisition risk; OPTINV indicates optimal-risk acquisitions which is actual acquisition risk the same as predicted acquisition risk; OVEINV indicates over-risk acquisitions which is actual acquisition risk higher than predicted acquisition risk. When acquisition risk is proxied by target industry R&D intensity, OPTINV is all the acquisitions whose actual risk level is within the range of (-90%, +110%) of the predicted risk level. UNDINV is acquisitions whose actual risk level is below 90% of the predicted risk level. OVEINV is acquisitions whose actual risk level is above 110% of the predicted risk level. N = number of acquisitions.

		Panel A: Acquisitions 1993-1997			*Panel B: Acquisitions 1998-2000*		
		N	**Sample size**	**% of sample**	**N**	**Sample size**	**% of sample**
Target high-tech Industry status	**UNDINV**	47	285	16.49	64	293	21.84
	OPTINV	182	285	63.86	182	293	62.12
	OVEINV	56	285	19.65	47	293	16.04
Target industry R&D intensity	**UNDINV**	141	285	49.47	130	293	44.37
	OPTINV	51	285	17.89	40	293	13.65
	OVEINV	93	285	32.63	123	293	41.98

measured by target high-tech status. Moreover, there are also far more acquisitions in the optimal-risk group when acquisition risk is measured by target high-tech status than when it is measured by target industry R&D intensity. There could be two reasons for this. First, a measure of acquisition risk by target high-tech industry status categorises all acquisitions into two categories, which misses out technology differences across firms and leads to biased predictions of acquisition risk levels. In contrast, there is less loss of information when acquisition risk is proxied by target industry R&D intensity, such a measure can therefore have more accurate predictions than the two-category measure.

The second reason is that the cut off points for determining the optimal-risk group when acquisition risk is measured by target industry R&D intensity is subjective. A change of the cut off points may change the number of acquisitions in the each risk group. Luckily, as discussed in footnote 150, the cut off point problem does not affect multiple regression analysis. Overall, as addressed in Section 7.4.5 of Chapter 7, the prediction based on the OLS regressions in which the dependent variable is target industry R&D intensity is more reliable than that based on the logistic regressions in which the dependent variable is target high-tech status.

8.3 Long-term post-acquisition performance

To analyse the relationship between acquirer post-acquisition performance and the level of optimal/suboptimal acquisition risk, the thesis first calculates acquirer post-acquisition performance . This thesis examines acquirers' buy-and-hold-abnormal-returns (BHARs) three years after acquisition effective month. The event study methodology is discussed Section 6.5.3 of Chapter 6. The three-year BHARs for acquirers are presented in Table 8-2, in Panel A for the sample period 1993-1997 and in

Table 8-2: Acquirers' 3-year BHARs by acquisition risk and sample period

This table reports acquirers' BHARs in % up to 3 years. The benchmark firm is matched on acquirer's industry, size, book-to-market and stock price momentum prior to acquisition announcement. Panel A reports the results for acquisitions during 1993-1997 and Panel B shows the results for acquisitions during 1998-2000. N= number of acquisitions. Figures in parentheses are t statistics for student's t test and z statistics for Fisher's sign test, Wilcoxon signed–rank test or Wilcoxon rank sum test, all based on two-tailed tests. Fisher's sign test (s) and Wilcoxon signed-rank test (w) are both tests for median. The lower test statistics between these two tests are reported. However, if one test shows a significant result while the other does not, the significant z statistic is reported and the sign for this test is written behind the test statistic. Wilcoxon rank sum test is used to test for group median difference. a, b and c represent 1%,, 5% and 10% levels of significance respectively.

	Panel A: Acquisitions over 1993-1997			*Panel B: Acquisitions over 1998-2000*		
	High-tech acquisitions	**Low-tech acquisitions**	**Group difference**	**High-tech acquisitions**	**Low-tech acquisitions**	**Group difference**
N	124	161		165	128	
1-12 months:						
Mean	0.84 (0.12)	-3.90 (-0.73)	4.74 (0.55)	-0.56 (-0.07)	-17.05 (-2.45)^{b}	16.5 (1.58)
Median	7.34 (0.11)	0.06 (0.00)	7.28 (0.25)	-16.14 (-1.78)^{c}	-14.94 (-1.98)^{b}	-1.20 (-0.37)
1-24 months:						
Mean	-11.66 (-0.27)	-10.11 (-1.20)	-1.55 (0.04)	-3.04 (-0.28)	-16.57 (-1.79)^{c}	13.53 (0.95)
Median	12.37 (0.63)	-4.88 (-0.47)	17.25 (1.03)	-16.50 (-2.65)^{a}	-10.45 (-1.89)^{c}	-6.05 (-0.18)
1-36 months:						
Mean	17.71 (0.43)	-25.51 (-2.21)^{b}	43.21 (1.00)	-13.82 (-1.34)	-23.71 (-2.22)^{b}	9.89 (0.66)
Median	15.63 (2.10)^{b} w	-10.31 (-1.42)	25.94 (1.63)^{c}	-8.64 (-2.86)^{a}	-12.55 (-1.75)^{c} w	3.91 (0.07)

Panel B for the 1998-2000 sample period. The benchmark firm is matched on acquirer's industry, size, book-to-market ratio and stock price momentum prior to acquisition announcement month.

For the 1993-1997 sample period and compared with industry, size, book-to-market and momentum matched firms, the average three-year post-acquisition performance of acquirers who bought high-tech targets is insignificantly different from 0, but the median (15.63%) is significant at the 5% level for the Wilcoxon signed rank test. Kohers and Kohers (2001) examine post-acquisition performance by using industry adjusted BHARs, and size and BEME adjusted BHARs. They report significantly negative 3-year post-acquisition BHARs for acquirers that conducted high-tech acquisitions. Comparing their finding with those of this thesis, it appears that UK acquirers seem to outperform their US counterparts when buying high risk high-tech target firms in the period of 1993-1997. However, as discussed below, for the 1998-2000 sample period, this better performance of UK acquirers disappears.

The findings presented in this thesis are similar to that of Conn *et al* (2005). Based on 197 UK high-tech as well as private acquisitions, i.e., acquisitions of privately held high-tech targets, during 1984-1998, Conn *et al* find that on average acquires achieve insignificant calendar time abnormal returns (CTARs) relative to firms of their similar size and book-to-market ratio 3 years after acquisitions. Expanding their sample to 308 acquisitions of both privately held-targets and publicly-held targets, they still find insignificant post-acquisition CTARs.

Conn *et al*'s study is similar to this thesis in that both studies examine high-tech as well as private acquisitions; both use a control firm approach, both sample periods covering 1993 to 1997, and both study UK domestic acquisitions. Although Conn *et al* report CTARs and this study reports BHARs, Conn *et al* actually use both approaches and find that the results produced by CTARs for private acquisitions are quite similar to BHARs both in terms of magnitude and statistical significance. Nevertheless, I acknowledge that there still exist differences between these two studies. Their definition of high-tech industries, although also based on firms' technology level, is broader than that used in this study (see footnote 53). Moreover, they define high-tech acquisitions as acquisitions in which acquirer and target are both in high-tech industries, whereas this thesis defines high-tech acquisitions as acquisition whose targets are in high-tech industries[151]. This thesis uses industry and firm stock momentum in addition to size and book-to-market as matching criteria to find a matching firm, whereas they only use the latter two.

Table 8-2 reports that the average 3-year BHARs for acquirers that bought low-tech targets is significantly negative with a value of -25.5% and an insignificant median of -10.3%. The average stock returns of acquirers in the high-tech acquisition group are 43.2% higher than those of acquirers in the low-tech acquisition group, although the difference is not statistically significant. However, the median return of the former type of acquirers is 25.9% higher than the latter type and this difference is significant at the 10% level. Thus there is evidence that acquirers that conducted high risk high-tech acquisitions outperformed acquirers that undertook low-risk low-tech acquisitions during the period 1993-1997.

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[151] This thesis argues that regardless the industry classification of acquirers, buying high-tech targets is always riskier than buying low-tech targets. This line of argument has been made in Section 5.2 of Chapter 5 and Section 6.2.1.1 of Chapter 6.

In contrast, Conn *et al* (2005) report insignificant average 3-year CTARs for non-high-tech, private acquisitions for 2,368 UK domestic acquisitions over the period 1984-1998. They reach the same conclusion when they expand the sample to 2,896 acquisitions including both public acquisitions and private acquisitions. The difference between the Conn *et al* study and this thesis may be due to the difference in the sample selections used by these two studies. The low-tech acquisitions examined in this thesis are selected according to the characteristics of their matching high-tech acquisitions so that the results for high-tech acquisitions and low-tech acquisitions are comparable. Conn *et al* however do not set such a constraint but include most of the acquisitions that happened during their sample period into their sample.

In this thesis, for the sample period 1998-2000, the average 3 year BHARs for acquirers that bought high-tech targets is -13.8% with a median of -8.6% (significant at the 1% level). Therefore, it appears that companies that bought high-tech targets during the high-tech boom experienced significant value destruction. In comparison, firms that bought low-tech targets experienced more value loss three years after making acquisitions. For these acquirers, the average BHAR is -23.7% (significant at the 5% level) and the median BHAR is around -13% (significant at the 10% level) for the Wilcoxon signed rank test. Although acquirers of high-tech targets outperform acquirers of low-tech targets, neither mean nor median difference is statistically significant.

Acquirer 1-year and 2-year BHARs are also reported to give further insight into acquirer performance after acquisitions. In the 1993-1997 sample period, acquirers of high-tech targets have BHARs that improve year by year in terms of median value. In terms of mean value, the BHAR is insignificantly negative at around -12% at the end of year 2, but turns positive, although still insignificant, at around 18% at the end of year 3. Acquirers of low-tech targets have negative BHARs for the whole 3-year period except for a median BHAR for the first year of 0.06%. Both mean and median BHARs get lower and lower year by year, indicating that the performance of acquirers in the low-tech acquisition group deteriorates year by year. Overall, the above results show that acquirers of high-tech targets performed better year by year but acquirers of low-tech targets performed worse year by year.

However, acquirers of high-tech targets did not perform as well in the peak of the bull market of 1998-2000 as they did in the 1993-1997. Their BHARs are negative in each of the 3 periods both in terms of mean and median values. On average the negative BHARs got worse and worse year by year. Acquirers of low-tech targets have the same performance pattern as the acquirers of high-tech targets, but to an even greater magnitude. As in the 1993-1997 sample period, firms that bought low-tech targets in the 1998-2000 sample period never outperformed their benchmark firms in any of the years.

An issue worth mentioning here is the reliability of the tests reported in Table 8-2. Lyon *et al* (1999) state that the problem of biased test statistics caused by cross-sectional dependence of stock returns is more serious with long-term event studies because overlapping event windows which cause cross-section dependence of stock returns, are more likely with long-term event windows. Table 8-2 reports results for event windows from 1 year up to 3 years and the patterns of BHARs remain similar across different event windows. To illustrate, during the 1998-2000 sample period, acquirers of high-tech targets have insignificant mean BHARs, while acquirers of low-tech targets have significantly negative mean BHARs in all three event windows, (0, +1 year), (0, +2 years) and (0, 3 years). The former acquirers thus outperform the latter acquirers regardless the length of the event windows. It therefore appears that cross-sectional dependence of firm stock returns has little impact on the conclusions drawn in this thesis with regard to the performance of acquirers in the high-tech acquisition group relative to the performance of acquirers in the low-tech acquisition group.

Lyon *et al* (1999) state that calendar-time-abnormal-returns (CTARs) can eliminate cross-sectional dependence of stock returns by aggregating the returns on sample firms into a single portfolio thus avoiding the problem of the correlation of returns (see Footnote 130). Conn *et al* (2005) use both CTARs and BHARs for privately-held acquisitions and find that results produced by CTARs are quite similar to the results produced by BHARs both in terms of magnitude and statistical significance. Nevertheless, I acknowledge that long-term event study has of methodological shortcomings. I summarise the areas for improvement in this thesis in Section 9.3 of Chapter 9.

In addition to using the control firm approach to identify a benchmark to calculate abnormal returns for acquirers, I also use the control portfolio approach based on acquirer industry classification to provide a robustness check on the conclusion drawn on acquirer post-acquisition performance. How the control portfolios are constructed is discussed in the text following Table 8A-1 in the appendix to this chapter, and BHARs calculated based on the control portfolios are reported in Table 8A-1. Similar results for 3-year BHARs are found when this alternative approach is used. Acquirers in the low-tech acquisition group on average experience value destruction 3 years after acquisitions have taken place. By contrast, acquirers in the high-tech acquisition group, although they do not gain significantly positive abnormal returns relative to their industry peers, outperform acquirers in the low-tech acquisition group.

The above results with regards to acquirer post-acquisition performance are generally consistent with the abundant empirical evidence that shows M&As on average destroy shareholder value. The following studies provide US evidence. Malatesta (1983) finds statistically significant cumulative abnormal returns (CARs) of -7.6% one-year after mergers. Jensen and Ruback (1983) who surveyed seven studies, report an average CAR of -5.5% one-year after mergers. Magenheim and Mueller (1988) report a significant CAR of -2.4% three-year after mergers. In a comprehensive analysis of post-merger stock performance based on a large sample of mergers over a 30-year period, Agrawal *et al* (1992) find that acquiring firms suffer a statistically significant wealth loss of approximately -10% over a five-year post-merger period. Anderson and Mandelker (1993) also find significant average five-year CARs of around -9.5%. Loughran and Vijh (1997) report a statistically significant five-year BHAR of -15.9% following mergers relative to a size and book-to-market adjusted benchmark. Rau and Vermaelen (1998) use a size and book-to-market adjustment method and report a statistically significant –4% for three-year CARs. In their literature review paper, Agrawal and Jaffe (2000) conclude that long-run post-acquisition stock performance is significantly negative regardless whether BHARs or CARs are used to calculate post-acquisition stock returns. Firth (1980), Frank and Harris (1989), Limmack (1991), Kennedy and Limmack (1996), and Gregory (1997) draw similar conclusions using UK data. For instance, Franks and Harris (1989) use a large comprehensive sample of 1,800 UK acquisitions between 1955-1985 and find that acquiring firms suffer significant wealth loss 2 years (CAR = -12.6%) after acquisition. Limmack (1991) uses three benchmarks, and finds that all benchmarks produce significantly negative CARs in the 2-year period following acquisitions, with an average CAR of -9%. Gregory (1997) uses six benchmarks and finds that the 2-year CARs are significant and between -11.8% to -18%.

A growing body of literature, e.g., Chang (1998) and Fuller *et al* (2002), reports that acquirers experience positive returns when buying non-public targets. This finding however is not supported by this study. As reported in Table 7-1 in Chapter 7, more then 90% of the sample in this study consists of non-public targets. Except for the median 3-year BHAR for the acquirers of high-tech targets in the 1993-1997 sample period, none of the mean or median BHARs during the 3 years following acquisition are significantly positive. The conclusion remains robust when an alternative benchmark to industry, size, book-to-market and momentum matched firms, i.e., industry control portfolios, is used (see Table 8A-1 in the appendix to this chapter).

The finding of this study is similar to that of Conn *et al* (2005) who conduct a broad study into UK acquisitions between 1984 and 1998. After using a variety of approaches suggested by the long-term event study literature including CARs, BHARs, and CTARs, they conclude that UK domestic acquisitions for privately held target firms on average do not bring acquirer shareholders any significant returns 3 years after acquisitions, but they also do not significantly destroy acquirer shareholder value. This thesis however does find that buying a privately-held, low-tech company destroy acquirer' shareholders' value 3 years following the acquisition. This difference in findings between this thesis and the Conn *et al* (2005) study was discussed earlier in this section.

Overall, this thesis finds that firms that bought high-tech targets either have significantly negative performance 3 years after acquisitions or their performance is insignificantly different from zero during the bull stock market of 1998-2000. In the 1993-1997 sample period, acquirers that bought high-tech targets on average do not have significantly negative returns. This indicates that the realisation of the expected growth options depends on market conditions. This study also shows that firms that bought high-tech targets in general do not underperform firms that acquired low-tech targets, and may even significantly outperform them. This indicates that high risk acquisitions do not necessarily destroy more value than low risk acquisitions. Indeed they may even create more value even though the difference is not always significant. This conclusion also holds for post-acquisition periods shorter than 3 years as shown in Table 8-2 and Table 8A-1 (in the appendix to this chapter).

8.4 Univariate analysis of 3-year BHARs on acquisition risk types

Table 8-3 reports the means and medians of the 3-year BHARs of each of the acquisition risk groups generated based on the prediction of Model 3 in Table 7-7 to Table 7-10. Table 8-4 shows the mean and median differences between these three acquisition risk groups and their significance levels.

For the sample period 1993-1997, the mean 3-year BHAR of the under-risk group (UNDINV) is -37% (number rounded up) when the proxy for acquisition risk is target high-tech industry status, whereas the median value is about –20% and significant at the 10% level based on Wilcoxon signed rank test. The average BHAR of the optimal-risk group (OPTINV) is around 15% and the median is about 1%. However neither of them is statistically significant. The mean (median) of the over-risk acquisition group (OVEINV) is around –52%(22%), both of which are statistically

Table 8-3: Acquirer 3-year BHARs in different acquisition risk groups

This table shows the mean and median BHARs of each acquisition risk group generated following Model 6-2 or Model 6-3 in Chapter 6. Model 3 in Table 7.7 to 7.10 is used as the prediction model for optimal acquisition risk. Panel A reports results for acquisitions over 1993-1997 and Panel B report results for acquisitions over 1998-2000. N= number of acquisitions. UNDINV = under-risk acquisitions. OPTINV = optimal-risk acquisitions. OVEINV = over-risk acquisitions. Figures in parentheses are t statistic for student's t test and z statistic for Fisher's sign test or Wilcoxon signed–rank test, all based on two-tailed tests. Fisher's sign test (s) and Wilcoxon signed-rank test (w) are both tests for median. The lower test statistics between these two tests are reported. However, if one test shows a significant result while the other does not, the significant z statistic is reported and the sign for this test is written behind the test statistic. a, b and c represent for 1%, 5% and 10% respectively.

Proxy for acquisition risk	Acquisition risk group	N	Mean	Median
	Panel A: acquisitions over 1993-1997			
Target high-tech Industry status	UNDINV	47	-37.07 (-1.59)	-20.12 (-1.66) [c] w
	OPTINV	182	14.96 (1.08)	0.65 (0.07)
	OVEINV	56	-51.62 (-0.61)	22.42 (0.94)
Target industry R&D intensity	UNDINV	141	-25.01 (-2.01)[b]	-12.24 (-1.65) [c] w
	OPTINV	51	7.12 (0.24)	-10.31 (-0.77)
	OVEINV	93	13.48 (0.25)	26.92 (-2.28) [b]
	Panel A: acquisitions over 1998-2000			
Target high-tech Industry status	UNDINV	64	-36.84 (-2.22)[b]	-33.31 (-1.88)[c]
	OPTINV	182	-24.49 (-2.29) [b]	-10.89 (-3.72) [b]
	OVEINV	47	31.92 (1.54)	9.49 (0.88)
Target industry R&D intensity	UNDINV	130	-26.95 (-2.61) [a]	-12.90 (-0.20) [b]
	OPTINV	40	-27.79 (-1.71) [c]	-13.68 (-1.96)[b]
	OVEINV	123	-5.69 (-0.44)	-5.63 (-1.62)

Table 8-4: Group differences of acquirer 3-year BHARs

This table shows group differences in the mean and median 3-year BHARs. Acquisition risk groups are generated following Model 6-2 or Model 6-3 in Chapter 6. Model 3 in Table 7.7 to 7.10 is used as the prediction model for optimal acquisition risk. Panel A reports results for acquisitions over 1993-1997 and Panel B report results for acquisitions over 1998-2000. N= number of acquisitions. UNDINV = under-risk acquisitions. OPTINV = optimal-risk acquisitions. OVEINV = over-risk acquisitions. Figures in parentheses are t statistics for student's t test and z statistic for Wilcoxon rank sum test, all based on two-tailed tests. a, b and c represent for 1%, 5% and 10% respectively.

Proxy for acquisition Risk	Acquisition risk group	Mean difference	Median difference
Panel A: Acquisitions over 1993-1997			
Target high-tech industry status	UNDINV vs OPTINV	-52.03 (-1.75) [b]	-20.77 (-1.64)[c]
	OVEINV vs OPTINV	-66.58 (-0.77)	21.77 (0.84)
Target industry R&D intensity	UNDINV vs OPTINV	-32.13 (-0.99)	-1.93 (-0.16)
	OVEINV vs OPTINV	6.36 (0.10)	37.23 (2.37)[b]
Panel A: Acquisitions over 1998-2000			
Target high-tech industry status	UNDINV vs OPTINV	-12.35 (-0.69)	-22.42 (-0.88)
	OVEINV vs OPTINV	56.41 (2.50) [a]	20.38 (2.90) [a]
Target industry R&D intensity	UNDINV vs OPTINV	0.83 (0.04)	0.78 (0.33)
	OVEINV vs OPTINV	22.1 (1.07)	8.05 (1.19)

insignificant. The large difference between the mean and the median value in the over-risk acquisition group indicates that over-risky acquisitions have very uncertain outcomes. They can have large positive returns such as 22%, they may also have returns as low as –52%.

With target industry R&D intensity as the independent variable, the average 3-year BHAR for the under-risk acquisition group (UNDINV) is –25% (significant at the 5% level) and the median is –12% (significant at the 10% level according to Wilcoxon signed rank test). This indicates that under-risk acquisitions destroy shareholder value over the long-run. Optimal-risk acquisitions (OPTINV) have a mean BHAR of 7% and a median BHAR of –10%, both are statistically insignificant. Interestingly, over-risk acquisitions (OVEINV) appear to have the best performance out of the three acquisition groups. Its median value is around 27% and significant at the 10% according to the Wilcoxon signed rank test. This means that acquisitions initiated by overconfident/over-optimistic/hubris-ridden directors can actually create value for shareholders.

In the 1998-2000 sample period, the under-risk group based on the logistic regression has a mean BHAR value of –37% (significant at the 5% level) and a median value of –33% (significant at the 10% level). This again shows that under-risk acquisitions destroy shareholder value. The average BHAR of the optimal-risk group (OPTINV) is –25% (significant at the 5%) and the median is –11% (significant at the 5% level). The only group which does not destroy shareholders' value is the over-risk acquisition group. It has mean and median values which are both insignificantly different from zero. These results again show that directors' pursuit of high-risk high-tech acquisitions, even though driven by their misjudgement of acquisition risk, may at least not destroy shareholder value, whereas directors who are conservative in selecting risky projects can make their firms lose their competitive advantage and cause their shareholder value loss over the long run. The same evidence is found when acquisition risk is measured by target industry R&D intensity.

Summarising Table 8-3 and Table 8-4, it appears that BHARs monotonically increase from UNDINV to OVEINV except the mean values in Panel A of Table 8-3. The most value destroying acquisitions are under-risk acquisitions and the least value destroying are over-risk acquisitions. Over-risk acquisitions also often significantly enhance shareholder wealth. This finding however, is not fully consistent with hypothesis *H12* that both under-risk and over-risk acquisitions lead to negative post-acquisition performance.

Taken together, the univariate analysis presented here shows that optimal-risk acquisitions outperform under-risk acquisitions but underperform over-risk acquisitions. Evidence is found that under-risk acquisitions significantly underperform industry peers that have similar size, book-to-market and stock price momentum 3 years after acquisitions. Optimal-risk acquisitions predicted by the empirical risk model based on managerial wealth incentives, managers' behavioural biases and corporate monitoring, have similar performance as firms of the same industry and of similar size, book-to-market ratio and stock price momentum 3 years following acquisitions in the period of 1993-1997. However, in the 1998-2000 period, the predicted optimal-risk acquisitions under-perform their benchmarks. By contrast, acquirers in the over-risk acquisition group generally have the same performance as their benchmark firms. They even significantly outperform their benchmark firms. In addition, over-risk acquisitions generally have better performance than both under-risk acquisitions and optimal-risk acquisitions[152]. These results imply that UK directors display excessive risk avoidance and thereby forgo value-enhancing projects. Behavioural biases however can drive them to make risky acquisitions that result in shareholder value enhancement. To further examine the robustness of the results from the univariate analysis, multiple regression analysis is presented in the following section.

8.5 Multiple regressions of long-run post-acquisition value gains

Table 8-5 reports the OLS regression results on 3-year BHARs for acquisitions during 1993-1997 and 1998-2000. Under-risk acquisitions (UNDINV) and over-risk acquisitions (OVEINV) are generated following Model 6-2 of Chapter 6. Model 3 of the binary logistic regressions reported in Table 7-7 and Table 7-9 is used to predict the optimal acquisition risk in Model 6-2. How UNDINV and OVEINV are coded has been discussed in Section 6.2.2.2 of Chapter 6. Briefly, a dummy variable is allocated to indicate a UNDINV acquisition with a value of 1 for such an acquisition and 0 otherwise. The OVEINV group is similarly coded. To avoid perfect collinearity (Gujarati, 2003, Chapter 6), the optimal-risk acquisition group (OPTINV) is used as the reference group.

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[152] This holds except in Panel A of Table 8-3 where the average BHAR (-51.62%) of over-risk acquisitions is lower than those of under-risk acquisitions and optimal-risk acquisitions. However, none of the mean values is statistically significant, meaning that they are all insignificantly different from zero. The mean difference between the over-risk acquisition group and the optimal-risk acquisition group reported in Panel A of Table 8-4 is also insignificantly different from zero.

Table 8-5: OLS regressions of acquirer 3-year BHARs

This table reports the OLS regression results of 3-year BHARs for acquisitions over 1993-1997 (Panel A) and over 1998-2000 (Panel B). UNDINV = under-risk acquisition. OVEINV = over-risk acquisition. Optimal-risk acquisition group is used as the reference group. The acquisition risk groups are generated following Model 6-2 and using Model 3 in Table 7.7 and Table 7.9 as the prediction model for optimal acquisition risk. RESID = the level of suboptimal acquisition risk. It is generated following Model 6-3 and using Model 3 in Table 7.8 and Table 7.10 as the prediction model for optimal acquisition risk. NONCASH = 1 if acquisition currency includes stock and 0 otherwise. In parentheses are t statistics. None of the models is subject to heteroscedasticity according to the White (1980) heteroscedasticity test. a, b and c represent for the 1%, 5% and 10% significance level respectively.

	Panel A: Acquisitions over 1993-1997		*Panel B: Acquisitions over 1998-200*	
	Target high-tech industry status	**Target industry R&D intensity**	**Target high-tech industry status**	**Target industry R&D intensity**
Intercept	31.67 (1.71)[c]	22.57 (1.33)	-19.51 (-1.53)	-10.57 (-1.00)
UNDINV	-48.48 (-1.57)		-12.87 (-0.78)	
OVINV	-0.60 (-0.02)		47.13 (2.60)[a]	
RESID		9.81 (2.22)[b]		9. 46 (2.71)[a]
NONCASH	-30.72 (-1.36)	-28.56 (-1.27)	-6.85 (-0.50)	-13.03 (-0.96)
N	285	285	293	293
F-statistic	1.60	3.59[b]	3.03[b]	3.77[b]
Adjusted R^2	0.63%	1.79%	2.04%	1.86%

The level of suboptimality of acquisition risk (RESID) is generated following Mode 6-3 of Chapter 6. Model 3 of the OLS regressions reported in Table 7-8 and Table 7-10 is used as the prediction model for optimal acquisition risk. Unlike UNDINV and OVEINV which are dummy variables, RESID is a continuous variable. None of the regressions are subject to the heteroscedasticity problem according to the White (1980) heteroscedasticity test.

The coefficients for under-risk acquisitions (UNDINV) are negative but insignificant in both sample periods. Take the 1998-200 sample period for example. The coefficient of UNDINV is around –13%, indicating that the change from an optimal-risk acquisition to an under-risk acquisition makes acquirer shareholders lose 13% of their stock value three years after the acquisition completion benchmarked on the stock returns of the acquirer's industry peer which does undertake any acquisitions but has a similar size, book-to-market ratio and stock price momentum as the acquirer.

The coefficient for over-risk acquisitions (OVEINV) is around 47% (significant at the 1% level) in the 1998-2000 sample period, but is only –0.6% and statistically insignificant in 1993-1997. This means that in 1998-2000, the change from an optimal-risk acquisition to an over-risk acquisition made acquirer shareholders gain 47% of their share value three years after the acquisition. However, if the same thing had happened during the 1993-1997 period, acquirer shareholders would not have benefited from it at all.

The coefficients for suboptimal risk level, RESID, are around 9.5% and significant at the 5% in both sample periods. This means that the riskier the acquisition, the more the acquirer shareholders can gain from it.

The above multiple regression analysis results are not fully consistent with hypothesis *H12* that both under-risk and over-risk acquisitions lead to negative post-acquisition performance. In line with the finding based on the univariate analysis reported in the last section, the finding based on multiple regression analysis shows that under-risk acquisitions destroy acquirer shareholders' value, but over-risk acquisitions can sometimes bring value to shareholders even though they are driven by managerial overconfidence/over-optimism/hubris. This implies that that during 1993-2000, UK acquirer managers destroyed shareholder value by being too risk averse rather than being adventurous in their acquisition risk choices.

The coefficients of NONCASH are negative and insignificant across all the models, indicating that the noncash payment method do not destroy more value than pure cash offers in acquisitions. This finding does not support the overvaluation hypothesis which states that acquirer managers utilize their overvalued stock to buy target firms' real assets, but the overvaluation is corrected by the market after acquisitions (Myers and Majluf, 1984). The finding also does not support the argument of Martin (1996) that equity-involved pay for acquisitions can increase acquirer shareholders' value by making targets share the acquisition risk with acquirers. The finding of this study is not consistent with those of Loughran and Vijh (1997), Rau and Vermaelen (1998), Sudarsanam and Mahate (2003), Akbulut (2005) and Conn *et al* (2005) who all find that noncash payment destroy more acquirer shareholder value than cash payment.

Taken together, the multiple regression analysis shows that from 1993 to 2000, UK acquirer managers destroyed shareholder value by being too risk averse rather than being adventurous in their acquisition risk choices. Noncash payment method does not destroy more shareholder value than cash offers in acquisitions.

8.6 Post-acquisition performance and risk incentives

Up until this point, all the previous sections report the results based on the two-stage analysis of the relationship between firm performance and factors that influence mangers' incentives for risky acquisitions. As discussed in Section 2.5 of Chapter 2 and Section 5.2 of Chapter 5, existing finance research generally ignores managers' choice on project risk while directly investigating the relationship between firm performance and factors that influence managers' risk incentives. Even those studies examining managers' risk-seeking behaviour induced by their behavioural biases, such as overconfidence/over-optimism/hubris, also do not establish a link between managers behavioural biases and managerial risk taking, but simply assume that managers, under the influence of their behavioural biases, undertake projects that destroy shareholder value[153]. This assumption is not always true according to my examination of the post-acquisition performance of high-tech and low-tech acquisitions based on the varied analyses discussed in the previous sections of this chapter. Overall, existing finance studies generally ignore the importance of managers' selection of project risk in examining the determinants of firm performance.

To provide a comparable analysis with those studies and to show that it is important to bring the managers' selection of project risk into the study of the relationship between firm performance and factors that affect managers' risk choices, this section reports the results of the regressions of acquirer post-acquisition

[153] See Section 3.3 of Chapter 3 for discussions about these studies.

performance, measured by 3-year BHARs, on risk incentives (see Table 8-6 and Table 8-7). The White (1980) heteroscedasticity test shows that heteroscedasticity problems occurred in Model 1 and Model 3 over the sample period 1993-1997 (Table 8-6), therefore the t-statistics are adjusted using the approach suggested by White (1980).

The coefficients of fixed pay and annual bonus (FAB) are insignificantly negative across all of the regression models, indicating that cash pay provides little incentive for managers to improve firm performance. In fact, it may have a negative influence on firm performance. This is consistent with the findings of Bertrand and Mullainathan (2001), Dial and Murphy (1991), Mehran (1995), and Conyon *et al* (1995) who conclude that cash compensation is not a strong incentive mechanism.

The finding based on the two-stage model proposed in this thesis suggests that fixed compensation and annual bonus may discourage managers to undertake risky acquisitions (see Section 7.4 of Chapter 7) and under-risk acquisitions destroy shareholder value (see Section 8.4 and Section 8.5). Therefore, the two-stage model explains how fixed compensation and annual bonus affect firm performance, unlike the one-stage model in Table 8-6 and Table 8-7.

The coefficients for LTIP cash (LTIP CASH) are positive across all the regression models but are only significant at the 5% level in Model 1 and Model 3 in the 1993-1997 sample period. These results provide some weak evidence that LTIP cash may contribute to the improvement of acquirers' performance. The two-stage model, however, does not demonstrate such evidence. As discussed in Section 7.4 of Chapter 7, LTIP cash generally has a negative but statistically insignificant impact on acquisition risk. Therefore the two-stage model implies that LTIP cash should not have an impact on acquirer post-acquisition performance.

Table 8-6 Regressions of acquirer 3-year BHARs on determinants of acquisition risk over 1993-1997

This table reports the OLS regression results on 3-year BHARs for acquisitions over 1993-1997. FAB = fixed compensation and annual bonus in £million. LTIPCASH = LTIP cash award in £million. DELTA= delta value of LTIP shares, and ordinary shares in £million. $DELTA^2$= the square root of DELTA. DELTA*WEALTH = the interaction of DELTA and WEALTH. WEALTH is the sum of fixed compensation, annual bonuses, LTIP cash, LTIP shares and ordinary shares in £million. PAST = % of acquirer stock returns of month –2 versus month –12 (month 0 is the announcement month). BEME = % of acquirer book value of equity to acquirer market value of equity. MEDIA= media praise for acquirer board of directors. LARSHR = % of large external block shareholdings. NEXE = % of non-executive directors on the board. NONDUAL = 1 if an acquirer's CEO and board chairman are different people and 0 otherwise. REM = 1 if an acquirer board has a remuneration committee and 0 otherwise. LEV = % of an acquirer's total liability over total assets. MV = the natural logarithm of acquirer market value of equity. RELSIZ =the natural logarithm of the size of acquirer to target. NONCASH= 1 if acquisition currency includes stock and 0 otherwise. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are t statistics. The t-statistics in Model 1 and Model 3 are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	**Model 2**	**Model 3**
Intercept	150.13(2.32)[b]	140.01(1.98)[b]	140.46(2.09)[b]
FAB	-33.65(-1.11)	-32.44(-1.20)	-32.37(-1.08)
LTIP CASH	612.79(1.82)[c]	585.38(1.32)	587.25(1.77)[c]
DELTA	-49.36(-0.66)	54.88(0.33)	60.30(0.30)
$DELTA^2$		-158.78(-0.68)	
DELTA*WEALTH			-1.19(-0.62)
PAST	0.21(0.68)	0.19(0.71)	0.19(0.62)
BEME	-0.30(-0.77)	-0.27(-0.70)	-0.27(-0.68)
MEDIA	25.28(2.19)[b]	25.39(2.22)[b]	25.39(2.18)[b]
LARSHR	0.63(1.10)	0.68(1.06)	0.68(1.16)
NEXE	-2.20(-1.96)[b]	-2.14(-2.48)[a]	-2.15(-1.94)[b]
NONDUAL	0.30(0.01)	1.31(0.05)	1.27(0.05)
REM	0.05(0.00)	0.35(0.01)	0.32(0.01)
LEV	0.34(0.50)	0.33(0.53)	0.33(0.49)
MV	-1.13(-0.09)	-1.50(-0.13)	-1.49(-0.12)
RELSIZ	-13.62(-1.34)	-13.74(-1.66)[c]	-13.74(-1.34)
NONCASH	-54.44(-2.34)[b]	-53.29(-2.25)[b]	-53.35(-2.26)[b]
N	285	285	285
F Statistics	1.85[b]	1.76[b]	1.75[b]
Adjusted R^2	4.03%	3.83%	3.82%

Table 8-7 Regression of acquirer 3-year BHARs on determinants of acquisition risk over 1998-2000

This table reports the OLS regression results on 3-year BHARs for acquisitions over 1998-2000. FAB = fixed compensation and annual bonus in £million. LTIPCASH = LTIP cash award in £million. DELTA= delta value of LTIP shares, and ordinary shares in £million. $DELTA^2$= the square root of DELTA. DELTA*WEALTH = the interaction of DELTA and WEALTH. WEALTH is the sum of fixed compensation, annual bonuses, LTIP cash, LTIP shares and ordinary shares in £million. VEGA = Stock option vega £million. VEGA*WEALTH = interaction of vega and wealth. PAST = % of acquirer stock returns of month –2 versus month –12 (month 0 is the announcement month). BEME = % of acquirer book value of equity to acquirer market value of equity. MEDIA= media praise for acquirer board of directors. LARSHR = % of large external block shareholdings. NEXE = % of non-executive directors on the board. NONDUAL = 1 if an acquirer's CEO and board chairman are different people and 0 otherwise. REM = 1 if an acquirer board has a remuneration committee and 0 otherwise. LEV = % of an acquirer's total liability over total assets. MV = the natural logarithm of acquirer market value of equity. RELSIZ =the natural logarithm of the size of acquirer to target. NONCASH= 1 if acquisition currency includes stock and 0 otherwise. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are t statistics. None of the models are subject to heteroscedasticity according to the White (1980) heteroscedasticity test. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	-23.73(-0.55)	-23.47(-0.54)	-22.20(-0.51)
FAB	-0.62(-0.11)	-0.52(-0.09)	-0.65(-0.12)
LTIP CASH	42.38(0.87)	44.83(0.91)	51.62(1.04)
DELTA	2.65(0.32)	10.14(0.43)	-0.30(-0.01)
$DELTA^2$		-1.34(-0.34)	
DELTA*WEALTH			-0.01(-0.35)
VEGA	-64.67(-0.92)	-69.22(-0.91)	-132.27(-1.47)
VEGA*WEALTH			0.69(1.31)
PAST	-0.05(-1.02)	-0.05(-1.03)	-0.05(-1.12)
BEME	0.25(1.23)	0.26(1.25)	0.25(1.22)
MEDIA	-5.19(-0.78)	-5.37(-0.80)	-5.18(-0.77)
LARSHR	0.39(0.95)	0.42(1.01)	0.44(1.04)
NEXE	-0.75(-1.40)	-0.75(-1.29)	-0.78(-1.46)
NONDUAL	23.14(1.35)	23.03(1.34)	21.98(1.28)
REM	52.08(1.67)[c]	51.14(1.64)[c]	50.63(1.62)
LEV	-0.39(-1.28)	-0.40(-1.30)	-0.39(-1.29)
MV	-3.61(-0.66)	-3.86(-0.70)	-2.64(-0.47)
RELSIZ	1.26(0.28)	1.26(0.28)	0.98(0.22)
NONCASH	-0.91(-0.06)	-1.06(-0.07)	-1.45(-0.10)
N	293	293	293
F Statistics	1.47	1.38	1.41
Adjusted R^2	2.37%	2.06%	2.31%

The coefficients for equity delta (DELTA) are insignificantly negative for Model 1 in both tables, indicating that equity delta provides little incentive for managers to improve firm performance. This is consistent with the literature summary presented by Ittner *et al* (2003). When the square of equity delta ($DELTA^2$) is included in the model (see Model 2), the coefficients of equity delta (DELTA) turn positive and the coefficients of the square of equity delta ($DELTA^2$) are negative. This indicates a nonlinear relationship between firm performance and equity delta. When the equity delta is low, it encourages managers to increase firm performance. When it is high, it causes managerial risk aversion which negatively affects firm performance. Mishra *et al* (2000) also suggest this nonlinear impact of equity delta on firm performance in their study (see Section 2.3.4.2 of Chapter 2). However, the results from this study lack statistical power because none of the coefficients are statistically significant. Therefore they do not provide strong support to the argument of Mishra *et* al (2000). Mishra *et* al's argument in fact implicitly explains the relationship between managerial risk taking and equity delta (see Section 2.3.4.2 for a detailed explanation). The empirical risk models (Model 2) reported in Table 7-7 to Table 7-10 provide better support for the argument of Mishra *et* al (2000). Those models demonstrate a significant concave relationship between acquisition risk and equity delta.

As is the case in the empirical risk models reported in Table 7A-4 to Table 7A-7, I also decompose equity delta into a delta for LTIPs (LTIP DELTA), a delta for stock options (OPTION DELTA), and a delta for managerial shareholdings (SHARE DELTA). The results are reported in Table 8A-2 and Table 8A-3. None of the deltas is shown to have any significant impact on acquirers' post acquisition performance.

As discussed in Section 7.4 of Chapter 7, existing studies, such as Morck *et al* (1988)[154], and McConnell and Servaes (1990) [155] tend to use the percentage of shares held by managers as a measure for the incentive provided by managerial shareholdings and find that there exist a concave relationship between firm performance and managerial shareholdings. Therefore, I use the same proxy for managerial shareholdings and report the results in Table 8A-4 [156]. The coefficients for the percentage of shares held by acquirer board directors (MANSHR) and its squared term ($MANSHR^2$) have mixed signs for two regression models over the two sample periods, all of which are statistically insignificant. These results again suggest that managerial equity ownership has no impact on acquirer post-acquisition performance, which is inconsistent with the argument put forward by Morck *et al* (1988), McConnell and Servaes (1990).

Therefore, this one-stage analysis shows that viewing each component of equity-based compensation separately, produces the effect that none of them has any influence on firm performance. This is inconsistent with the findings of Datta *et al* (2001) who find that stock options and restricted stocks encourage directors to conduct acquisitions

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[154] Morck *et al* (1988) investigate the relationship between management ownership and market valuation of a firm, as measured by Tobin's Q. They find evidence of a significant nonmonotonic relationship between these two. Tobin's Q first increases, then declines at the point where managers own 5%, and finally rises slightly as the ownership rises at 25%.

[155] McConnell and Servaes (1990) report a significant curvilinear relation between Tobin's Q and the fraction of common stock owned by corporate insiders. The curve slopes upward until insider ownership reaches approximately 40% to 50% and then slopes slightly downward.

[156] The empirical risk models that use this proxy for managerial shareholders are in Table 7A-8 to Table 7A-11.

that create value. By contrast, the two-stage analysis shows that out of all the equity-based wealth components, at least managerial shareholdings have a nonlinear impact on managers' selection of acquisition risk, which in turn affects post-acquisition performance. This conclusion is robust when two different measures are used, share delta and the percentage of shares held by managers (see Section 7.4 of Chapter 7 for a detailed discussion)

In Table 8-6 and Table 8-7, the coefficients of the cross term of equity delta and total wealth (DELTA*WEALTH) are both insignificantly negative. As discussed earlier, the impact of equity delta on post-acquisition performance is also insignificant. Therefore it is hard to draw any inference from these results with regard to the impact of wealth on the incentive provided by equity delta in the one-stage model.

The coefficients for option vega (VEGA) are insignificantly negative in all of the models in Table 8-7, meaning that the convexity of stock options does not encourage managers to take more risk to improve firm performance. The two-stage analysis discussed (see Section 7.4 of Chapter 7) shares the same conclusion for option vega. The interaction of vega and wealth (VEGA*WEALTH) is also statistically insignificant in Model 3 of Table 8-7. As is the case with the impact of total wealth on equity delta, it is hard to tell how total wealth influences the incentive provided by option vega because option vega is shown to produce very little risk-taking incentive.

As with Table 7A-15 and Table 7A-16 in the Appendix to Chapter 7, I use deflated wealth variables in the regression models. All the wealth variables are deflated by firm size as measured by acquirer total assets (in the accounting year prior to acquisition) to capture the difference in the compensation level of firms of different sizes. I run the same regressions[157] as those whose outputs are reported in Table 8-6 and Table 8-7 and report the results in Table 8A-6 and Table 8A-7 in the Appendix to this Chapter. The results are similar to those in Table 8-6 and Table 8-7. None of the components of managerial wealth appear to have any significant impact on acquirer post-acquisition performance .

Overall, one-stage analysis on the relationship between post-acquisition performance and various components of managerial wealth suggests that none of the components of managerial wealth has any significant impact on post-acquisition performance. This does not support the traditional agency argument that equity based-compensation and managerial shareholdings can align the interests of managers and shareholders. It is inconsistent with the findings of Mehran *et al* (1998), Datta *et al* (2001) and Hanlon *et al* (2003) who find that stock options contribute to a better firm performance, and with McConnell and Servaes (1990) and Morck *et al* (1988) who suggest a nonlinear impact of managerial shareholdings on firm performance.

Regarding the three behavioural bias variables, all of them have mixed signs across the models. Media praise (MEDIA) is the only variable that achieves statistically significant coefficient in the 1993-1997 sample period, but such significance disappears in the 1998-2000 sample period. The significantly positive coefficients of media praise (MEDIA) in the 1993-1997 sample period mean that managers' overconfidence/hubris which is inflated by a high and flattering media profile, can drive managers to make value creating acquisitions. This is contradictory to the argument put forward by Hayward and Hambrick (1997) that managerial hubris can only lead to value destroying

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[157] The other difference between these groups of tables is that institutional blockholdings (INSTSHR) are included in the model rather than external blockholdings.

acquisitions. The two-stage analysis can explain why directors' behavioural biases can lead to value creating acquisitions. The empirical risk models reported in Table 7-7 to Table 7-10 in Chapter 7 show that managerial behavioural biases induce managers to take more risks. This is consistent with the argument of Hayward and Hambrick (1997). What Hayward and Hambrick fail to account for in their models is that such managerial risk taking can actually increase firm performance because otherwise risk-averse managers may forego value-enhancing projects. This is shown in Table 8-3 to Table 8-5. Therefore, the two-stage analysis proposed by this thesis gives greater insights than the one-stage analysis. The insignificant coefficients for the behavioural variables again indicate that the one-stage analysis is not able to 'discover' the impact of behavioural biases on firm performance.

Table 8-6 and Table 8-7 do not report any significant results for the coefficients for external blockholders (LARSHR), meaning that external blockholders do not discipline managers to bring value to shareholders. Table 8A-6 and Table 8A-7 also do not report significant results for institutional shareholders (INSTSHR), indicating that the existence of institutional shareholders does not help increase shareholder value by monitoring managers' behaviour. These findings therefore are consistent with Sudarsanam *et al* (1996), Frank *et al* (2001), and Weir *et al* (2002)[158] who all find that UK external blockholders exert little disciplining effect on managers.

Table 8-6 and Table 8-7 report that the coefficients for the board composition variable (NEXE) are negative and only statistically significant in 1993-1997, showing that a high proportion of non-executive directors on the board if not destructive to shareholder value, has no impact on firm performance. This finding supports the

[158] See Section 4.2.1 for a discussion of these studies.

argument of Mace (1971) that non-executive directors are literally under the control of executive directors and is consistent with the empirical findings of Weir (1997), Weir and Laing (2000), Frank *et al* (2001) and Weir *et al* (2002)[159].

Table 8-6 and Table 8-7 show that the coefficients for CEO-COB nonduality (NONDUAL) are not significant in any of the models, indicating that the supervision of a non-executive chairman does not necessarily cause a CEO to undertake value creating acquisitions. This finding is broadly consistent with Brickley *et al* (1997), Weir *et al* (2002), and Dahya (2003) who find that the nonduality of CEO and COB has no influence on corporate performance[160].

The existence of remuneration committees also has no impact on acquirers' long-term post-acquisition performance as shown in Table 8-6 and Table 8-7. This supports the view of Bebchuk and Fried (2004, Chapter 5 and Chapter 6) that remuneration committees could be ineffective due to the control held on them by managers.

Overall, the one-stage analysis shows corporate monitors such as external blockholders, non-executive directors, the separate roles of CEO and COB, and the presence of a remuneration committee on the board, are all ineffective in disciplining managers. The two-stage analysis also produces the same conclusion (see Section 7.6 of Chapter 7).

The coefficients for both financial leverage (LEV) and relative size of acquirer to target (RELSIZ) have mixed signs for the two sample periods. It is therefore, difficult to draw a clear conclusion regarding these two variables. Acquirer size (MV) is negatively related to acquirer 3-year BHARs across all of the regression models.

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[159] See Section 4.2.2 for a discussion of these studies.

[160] See Section 4.2.3 for a discussion of these studies.

However, all of the coefficients are statistically insignificant. Therefore it is hard to tell whether large companies conduct more value destroying acquisitions than small companies. The two-stage analysis also is not clear on the impact that acquirer financial leverage, the relative size of acquirer to target, and acquirer size have on managerial pursuit of acquisition risk, and therefore it is not able to reveal how those factors influence the acquirer post-acquisition performance as a result of managers' pursuit of acquisition risk.

Stock-mixed payment (NONCASH) is negatively associated with acquirer long-term post-acquisition performance. The coefficients are significant at the 5% level in the 1993-1997 sample period. This indicates that noncash payments destroy more shareholder value than cash offers. This result is the same as that reported in Table 8-7.

Overall, the direct examination of post-acquisition performance and various risk incentives show that most of the risk incentives cannot explain acquirers' long-term post-acquisition performance. On the other hand, the two-stage analysis employed in this thesis better demonstrates how those risk incentives influence managers' pursuit of acquisition risk, which in turn affects acquirer performance after acquisitions.

8.7 Summary

This chapter focuses on the examination of the relationship between firm performance and the optimal/suboptimal acquisition risk predicted by the empirical risk models reported in Model 3 in Table 7-7 to Table 7-10 in Chapter 7, i.e. stage two of the two-stage analysis. The first stage of the analysis investigates to what extent these factors are associated with the level of acquisition risk pursued by managers. This has been discussed in Chapter 7. The existing literature generally directly examines post-acquisition performance and the factors that influence managers' corporate investment decisions. I call this 'one-stage' analysis to distinguish it from the two-stage analysis adopted in the thesis. To identify the differences between these two approaches, as well as to provide comparable results with those studies that adopt one-stage analysis, I also conduct a one-stage analysis, examining the relationship between acquirer 3-year BHARs and the factors that influence managers to select acquisition risks. The following summarises the findings in this chapter.

All of the acquisitions in the sample of this thesis are categorized into under-risk, optimal-risk or over-risk acquisitions based on the predictions of Model 3 in Table 7-7 to table 7-10. The results of this process shows that the percentage of acquisitions in the over-risk acquisition category increases in the bull market of late 1990s when acquisition risk is measured as target R&D industry intensity.

Estimates of 3-year buy-and-hold abnormal returns in the post-acquisition period show that high-risk high-tech acquisitions do not necessarily destroy more acquirer shareholder value than low risk acquisitions. This conclusion also holds for post-acquisition periods shorter than 3 years.

A univariate analysis of the 3-year post-acquisition performance of each risk group shows that the optimal-risk acquisitions outperform under-risk acquisitions but underperform over-risk acquisitions. While under-risk acquisitions always destroy shareholder value, over-risk acquisitions often enhance shareholder value.

Multiple regression analysis shows that during both sample periods UK acquirer managers destroyed shareholder value by being too risk averse rather than by being adventurous in their acquisition risk choices. It also shows that that noncash offers may not destroy more shareholder value than pure cash offers.

A comparison against the one-stage analysis of the determinants of post-acquisition performance shows that the two-stage analysis which includes managers' selection of acquisition risk, can better explain post-project firm performance. This suggests that in future studies researchers should consider a two-stage analysis rather than trying to directly establish a link between firm performance and various risk incentives. The two-stage analysis provides richer insights into the linkage among risk incentives provided by managers' wealth, managerial risk taking and the subsequent corporate performance. It also allows us to examine how managerial behavioural biases affect this linkage.

I acknowledge that the conclusion drawn in this thesis that risky high-tech acquisitions which are mainly driven by managerial behavioural biases, can create value for shareholders is sample-specific and time-dependent. As discussed in Section 7.3 of Chapter 7, stock options have not yet outweighed cash compensation and become the dominant component of executive compensation in the UK. Therefore the prevalent criticisms that excessive grants of stock options encourage managerial excessive risk taking in the US are not applicable to the UK. If an analysis the same as the one adopted by this thesis is conducted based on the US data, the finding with regard to the incentive effect of stock options may be different from that of this thesis. Therefore, the conclusion by this study is sample-dependent.

The conclusion is also time-dependent because it is drawn upon the data from the unique telecom/technology/internet bubble period in the history, during which equity in telecom, internet or other technology-related sectors was overvalued. One effect of overvalued equity is that it inflated directors' overconfidence/hubris in their managerial capability, which in turn induced managers to relentlessly seek after target firms in these high-tech sectors so that they could quickly expand into these 'new' areas ahead of (or at least not behind of) their industry peers. An example is Jean Marie Messier who turned Vivendi Universal from a water company into a large modern media company through a series of acquisitions. During this period, internal corporate monitors seemed ineffective because companies as well as the mass media, worshipped 'superstar' CEOs.

Combing those observations, it is not hard to understand why this study finds that managerial behavioural biases are the major driving force behind high-risk high-tech acquisitions. Same evidence may not be apparent in the years following the stock market crash in early 2000 because the whole of society turned negative toward the roles of directors and criticised that those directors took far too much risk, jeopardising company survival. More corporate governance rules such as recommended by the Turnbull Report in the UK, and Sarbanes-Oxley Act were published in an attempt to more tightly monitor company directors' risk taking behaviour (Bennett, 2004; Crawford, 2005). Merger activities in the post-crash period mainly focused on cost reduction to reduce the overcapacity of the telecom and internet sectors. Therefore, if the post-bubble period would have been included in the sample, this thesis probably may not have been able to find that the major driving force behind high-tech acquisitions was managerial overconfidence/over-optimism/ hubris.

Appendix

Table 8A-1: Acquirers' 3-year BHARs matched on industry-adjusted control portfolio over 1993-1997

This table reports acquirers' BHARs in % up to 3 years. The benchmark is industry-adjusted portfolio. Panel A reports the results for acquisitions during 1993-1997 and Panel B shows the results for acquisitions during 1998-2000. N= number of acquisitions. Figures in parentheses are t statistics for student's t test and z statistics for Fisher's sign test, Wilcoxon signed–rank test or Wilcoxon rank sum test, all based on two-tailed tests. Fisher's sign test (s) and Wilcoxon signed-rank test (w) are both tests for median. The lower test statistics between these two tests are reported. However, if one test shows a significant result while the other does not, the significant z statistic is reported and the sign for this test is written behind the test statistic. Wilcoxon rank sum test is used to test for median difference. a, b and c represent 1%,, 5% and 10% levels of significance respectively.

	Panel A: Acquisitions over 1993-1997			*Panel B: Acquisitions over 1998-2000*		
	High-tech acquisitions	**Low-tech acquisitions**	**Group difference**	**High-tech acquisitions**	**Low-tech acquisitions**	**Group difference**
N	124	161		165	128	
1-12 months:						
Mean	7.23 (1.14)	-5.21 (-1.58)	12.43 $(2.05)^{b}$	-9.85 (-1.15)	-10.80 $(-2.83)^{a}$	0.95 (0.10)
Median	5.60 (0.99)	-4.64 $(-2.05)^{b}$	10.24 $(2.24)^{b}$	-14.48 $(-2.85)^{a}$	-8.31 $(-2.03)^{b}$	-6.17 (-0.19)
1-24 months:						
Mean	23.82 $(1.97)^{b}$	-10.50 $(-1.79)^{c}$	34.32 $(2.55)^{a}$	3.53 (0.40)	-24.87 $(-3.61)^{a}$	28.40 $(2.52)^{a}$
Median	-2.94 (-0.09)	-15.26 $(-2.83)^{a}$	12.32 $(2.34)^{b}$	-12.61 $(-1.97)^{b}$	-19.72 $(-2.91)^{a}$	7.11 (1.60)
1-36 months:						
Mean	24.07 (1.25)	-27.18 $(-3.09)^{a}$	52.15 $(2.39)^{a}$	-0.51 (-0.05)	-11.21 $(-1.97)^{a}$	10.70 (0.96)
Median	-6.60 (-0.81)	-31.02 $(-4.41)^{a}$	24.42 $(1.73)^{c}$	-15.61 $(-3.25)^{a}$	-12.89 $(-1.86)^{c}$	-2.72 (-0.12)

Industry matched control portfolios are formed based on the most detailed industry classification in Datastream, INDC6 (see Section 6.5.3 of Chapter 6 for a discussion of Datastream industry classifications). Each sample firm is allocated to a benchmark portfolio based on the INDC6 of the sample firm. There are 2 sample firms matched on a more general industry classification, INDC4 since no portfolio could be formed using INDC6 or INDC5. Same as the matched firm approach discussed in Section 6.5.3 of Chapter 6, for each sample firm, the benchmark portfolio is rebalanced once a year.

Table 8A-2: OLS regressions of 3-year BHARs over 1993-1997 with a breakdown of equity delta

This table reports the results for the regressions of acquirer 3-year BHARs over 1993-1997. It differs from Table 8-6 in that it reports the results for LTIP delta, share delta (highlighted in the table) rather than equity delta as a whole. The squared term of the delta for LTIP shares is dropped from the models because it is seriously correlated with the delta for LTIP shares (LTIP DELTA). The VIF ratio, 52, is far above the cut off point, 10. LTIP DELTA= delta value of LTIP shares in £million. LTIP DELTA*WEALTH = the interaction of LTIP DELTA and wealth. Wealth is the sum of fixed compensation and annual bonuses, LTIP cash, LTIP shares and managerial shareholdings in £million. SHARE DELTA= delta value of managerial shareholdings in £million. SHARE DELTA^2 = the squared term of the delta for managerial shareholdings. SHARE DELTA*WEALTH = the interaction term of SHARE DELTA and wealth. See Table 8-6 for the rest of the variable definitions. N = Number of acquisitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are t statistics. The t-statistics in model 1 are corrected by the White (1980) heteroscedasticity procedure. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	151.92(2.19)^b	141.72(2.00)^b	143.16(2.02)^b
FAB	-35.19(-1.27)	-34.18(-1.23)	-34.20(-1.23)
LTIP CASH	613.14(1.39)	584.74(1.31)	593.06(1.33)
LTIP DELTA	3.67(0.27)	4.27(0.31)	20.75(0.97)
LTIP DELTA *WEALTH			-0.35(-0.99)
SHARE DELTA	-0.05(-0.80)	0.05(0.31)	0.01(0.08)
SHARE DELTA^2		-0.00(-0.70)	
SHARE DELTA *WEALTH			-0.00(-0.27)
PAST	0.21(0.76)	0.19(0.69)	0.20(0.72)
BEME	-0.30(-0.82)	-0.28(-0.78)	-0.31(-0.80)
MEDIA	25.01(2.18)^b	25.07(2.18)^b	25.98(2.25)^b
LARSHR	0.65(1.10)	0.70(1.09)	0.72(1.12)
NEXE	-2.22(-2.57)^a	-2.17(-2.50)^a	-2.21(-2.54)^b
NONDUAL	0.26(0.01)	1.30(0.05)	0.57(0.02)
REM	-0.23(-0.01)	0.03(0.00)	0.20(0.01)
LEV	0.35(0.56)	0.34(0.55)	0.37(0.59)
MV	-0.93(-0.08)	-1.29(-0.11)	-1.52(-0.13)
RELSIZ	-13.73(-1.66)^c	-13.87(-1.67)^c	-13.76(-1.66)
NONCASH	-54.59(-2.31)^b	-53.42(-2.25)^b	-53.25(-2.24)^b
N	285	285	285
F statistics	1.73^b	1.65^b	1.60^c
Adjusted R^2	3.70%	3.52%	3.49%

Table 8A-3: OLS regressions of 3-year BHARs over 1998-2000 with a breakdown of equity delta

This table differs from Table 8-7 in that it reports the results for LTIP delta, option delta share delta rather than equity delta as a whole. The squared term of the delta for LTIP shares, option vega (VEGA) and the interaction of option vega and wealth (VEGA*WEALTH) are dropped from the models because the squared term of the delta for LTIP shares is seriously correlated with the delta for LTIP shares (LTIP DELTA); option vega (VEGA) and the interaction of vega and wealth (VEGA*WEALTH) are both seriously correlated with option delta (OPTION DELTA) and the interaction of option delta and wealth (OPTION DELTA*WEALTH). The VIF ratio for the squared term of LTIP delta is 15 and for the VEGA and VEGA*WEALTH is all above 50. OPTION DELTA = delta value of stock options in £million. OPTION DELTA^2 = the squared term of the delta for stock options. OPTION DELTA*WEALTH = the interaction of OPTION DELTA and wealth. See Table 8A-2 for definitions of LTIP DELTA, LTIP DELTA*WEALTH, SHARE DELTA, SHARE DELTA^2, and SHARE DELTA*WEALTH. See Table 8-7 for the definitions of the rest of the variables. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are t statistics. None of the models are subject to the heteroscedasticity problem according to the White (1980) heteroscedasticity test. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	-20.08(-0.47)	-8.24(-0.42)	-17.76(-0.41)
FAB	-1.61(-0.28)	-1.50(-0.26)	-1.07(-0.18)
LTIP CASH	40.14(0.82)	45.85(0.92)	43.08(0.86)
LTIP DELTA	0.35(0.71)	0.41(0.80)	0.60(1.05)
LTIP DELTA *WEALTH			-0.00(-0.73)
OPTION DELTA	-0.15(-0.88)	-0.37(-0.82)	-0.33(-1.57)
OPTION DELTA^2		0.00(0.51)	
OPTION DELTA *WEALTH			0.00(1.38)
SHARE DELTA	0.00(0.25)	0.01(0.49)	0.00(0.01)
SHARE DELTA^2		-0.00(-0.42)	
SHARE DELTA *WEALTH			-0.00(-0.20)
PAST	-0.05(-1.02)	-0.05(-1.01)	-0.06(-1.16)
BEME	0.25(1.21)	0.24(1.15)	0.23(1.12)
MEDIA	-5.51(-0.82)	-5.63(-0.83)	-5.54(-0.82)
LARSHR	0.42(1.02)	0.48(1.13)	0.45(1.07)
NEXE	-0.79(-1.46)	-0.80(-1.48)	-0.80(-1.48)
NONDUAL	23.01(1.35)	23.06(1.34)	22.46(1.30)
REM	52.05(1.67)^c	51.01(1.63)	51.21(1.64)
LEV	-0.43(-1.39)	-0.45(-1.45)	-0.43(-1.41)
MV	-3.59(-0.66)	-3.57(-0.64)	-3.19(-0.56)
RELSIZ	1.01(0.23)	1.02(0.23)	0.87(0.19)
NONCASH	-0.82(-0.06)	-0.86(-0.06)	-0.41(-0.03)
N	293	293	293
F Statistics	1.41	1.27	1.33
Adjusted R^2	2.20%	1.66%	2.08%

Table 8A-4: OLS regressions of 3-year BHARs with an alternative measure for managerial shareholdings

This table reports the results for the regressions of 3-year BHARs. It differs from Model 2 in Table 8A-2 and Table 8A-3 in that it uses the % of share held by acquirer board of directors as a proxy for managerial shareholdings (MANSHR), and it includes institutional blockholdings (INSTSHR) in the regressions rather than external blockholdings. MANSHR = % of ordinary shares, beneficial and non-beneficial, held by acquirer board of directors in the accounting year prior to acquisition announcement. $MANSHR^2$ = the squared term of MANSHR. INSTSHR = % of institutional blockholdings. See Table 8A-2 and Table 8A-3 for the definitions of the rest of variables. N = Number of acquisitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are t statistics. None of the models are subject to heteroscedasticity problem according to the White (1980) heteroscedasticity test. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Panel A: Acquisitions over 1993-1997	*Panel A: Acquisitions over 1998-2000*
Intercept	140.46(1.60)	-50.62(-1.01)
FAB	-26.72(-0.97)	-1.09(-0.19)
LTIP CASH	595.17(1.35)	42.65(0.87)
LTIP DELTA	0.39(0.03)	0.42(0.84)
OPTION DELTA		-0.33(-0.74)
OPTION DELTA^2		0.00(0.45)
MANSHR	-0.14(-0.07)	1.99(1.46)
MANSHR^2	0.01(0.26)	-0.03(-1.24)
PAST	0.22(0.82)	-0.05(-1.07)
BEME	-0.31(-0.80)	0.30(1.47)
MEDIA	26.47(2.29)^b	-5.07(-0.75)
INSTSHR	0.87(1.11)	0.45(1.01)
NEXE	-1.94(-2.30)^b	-0.73(-1.34)
NONDUAL	-1.32(-0.05)	26.62(1.55)
REM	-2.5(-0.07)	50.67(1.60)
LEV	0.29(0.46)	-0.45(-1.45)
MV	-3.91(-0.32)	-0.65(-0.12)
RELSIZ	-13.50(-1.63)	0.64(0.14)
NONCASH	-53.53(-2.24)^b	-0.11(-0.01)
N	285	293
F Statistics	1.56^c	1.36
Adjusted R^2	3.08%	2.18%

Table 8A-5 Acquirer 3-year BHARs on determinants of acquisition risk, 1993-1997 with deflated wealth variables

This table reports the results for the regressions of acquirer 3-year BHARs over the sample period of 1993-1997. It differs from Table 8-6 in that all the wealth variables defined in Table 8-6 are deflated by acquirers' total assets in the accounting year prior to acquisition announcement. In addition, it includes institutional blockholdings (INSTSHR) in the regressions rather than external blockholdings. INSTSHR = % of institutional blockholdings. See Table 8-6 for the rest of the variable definitions. N = Number of acquisitions. The outliers of the variables are winsorised to 2[nd] standard deviation from the sample mean. In parentheses are t statistics. None of the models are subject to the heteroscedasticity problem according to the White (1980) heteroscedasticity test. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	Model 2	Model 3
Intercept	128.10(1.47)	127.71(1.40)	125.87(1.38)
FAB	-0.62(-0.09)	0.66(0.09)	0.84(0.12)
LTIP CASH	2776.48(0.97)	2777.07(0.97)	2780.01(0.97)
DELTA	19.29(0.62)	20.13(0.31)	24.06(0.38)
$DELTA^2$		-0.43(-0.01)	
DELTA*WEALTH			-0.02(-0.09)
PAST	0.23(0.83)	0.23(0.83)	0.23(0.83)
BEME	-0.23(-0.58)	-0.23(-0.54)	-0.22(-0.53)
MEDIA	24.60(2.11)[b]	24.62 (2.09)[b]	24.74(2.10)[b]
INSTSHR	0.92(1.26)	0.92(1.25)	0.93(1.26)
NEXE	-1.69(-2.09)[b]	-1.69(-2.07)[a]	-1.68(-2.06)[b]
NONDUAL	-3.70(-0.14)	-3.73(-0.14)	-3.82(-0.14)
REM	0.02(0.00)	-0.04(0.00)	-0.33(-0.01)
LEV	0.26(0.41)	0.26(0.40)	0.25(0.39)
MV	-9.70(-1.05)	-9.66(-1.00)	-9.47(-0.98)
RELSIZ	-12.58(-1.52)	-12.59(-1.52)	-12.61(-1.52)
NONCASH	-53.03(-2.23)[b]	-53.00(-2.22)[b]	-52.88(-2.22)[b]
N	285	285	285
F Statistics	1.71[b]	1.59[c]	1.59[C]
Adjusted R^2	3.37%	3.01%	3.01%

Table 8A-6 Acquirer 3-year BHARs on determinants of acquisition risk, 1998-2000 with deflated wealth variables

This table reports the results for the regressions of acquirer 3-year BHARs over the sample period of 1998-2000. It differs from Table 8-7 in that all the wealth variables defined in Table 8-7 are deflated by acquirers' total assets in the accounting year prior to acquisition announcement. In addition, it includes institutional blockholdings (INSTSHR) in the regressions rather than external blockholdings. INSTSHR = % of institutional blockholdings. See Table 8-7 for the rest of the variable definitions. N = Number of acquisitions. The outliers of the variables are winsorised to 2nd standard deviation from the sample mean. In parentheses are t statistics. None of the models are subject to the heteroscedasticity problem according to the White (1980) heteroscedasticity test. a, b and c indicate significance level at the 1%, 5% and 10% respectively.

	Model 1	**Model 2**	**Model 3**
Intercept	-11.23(-0.23)	-7.73(-0.16)	-6.68(-0.13)
FAB	-2.00(-0.62)	-1.74(-0.53)	-1.78(-0.55)
LTIP_CASH	17.21(0.40)	16.19(0.37)	16.10(0.37)
DELTA	0.59(0.17)	-5.00(-0.52)	-4.60(-0.47)
DELTA^2		0.40(0.62)	
DELTA*WEALTH			0.00(0.44)
VEGA	9.55(0.32)	11.00(0.36)	5.66(0.13)
VEGA*WEALTH			0.01(0.17)
PAST	-0.06(-1.19)	-0.05(-0.95)	-0.05(-0.94)
BEME	0.27(1.33)	0.27(1.30)	0.27(1.29)
MEDIA	-5.46(-0.82)	-5.63(-0.84)	-5.61(-0.84)
INSTSHR	0.27(0.63)	0.23(0.54)	0.22(0.52)
NEXE	-0.67(-1.23)	-0.68(-1.25)	-0.68(-1.25)
NONDUAL	25.92(1.49)	26.28(1.51)	26.45(1.52)
REM	50.61(1.60)	49.19(1.55)	48.44(1.51)
LEV	-0.40(-1.27)	-0.39(-1.24)	-0.39(-1.24)
MV	-5.76(-1.18)	-5.79(-1.19)	-5.86(-1.20)
RELSIZ	1.03(0.23)	0.99(0.22)	1.04(0.23)
NONCASH	-0.93(-0.06)	-0.64(-0.04)	-0.42(-0.03)
N	293	293	293
F Statistics	1.38	1.31	1.23
Adjusted R^2	1.91%	1.69%	1.34%

Chapter 9

SUMMARY, CONCLUSIONS AND IMPLICATONS

9.1 Introduction

The aim of this thesis as stated in Chapter 1, is to examine managerial risk taking behaviour, and more particularly to identify the factors that influence managers' decisions on taking risky projects and to examine the impact of managerial risk taking on shareholder value. In light of this, as described in Section 5.2 of Chapter 5, the following two research questions are raised:

Q1: What are the factors that drive managers to undertake risky projects?

Q2: To what extent is firm performance related to the optimal or suboptimal risk level of an investment project?

Combining the views of traditional agency theory and of behavioural finance theory, I identify three major categories of factors that influence managerial risk taking. These three categories are: the components of managerial wealth, behavioural biases and corporate monitoring mechanisms. This thesis mainly investigates how these risk incentives influence managers' selection of project risk and how the selected project affects firm performance. This is done via the formulation of a two-stage analysis of the relationship between firm performance and the aforementioned risk incentives. Existing studies generally only conduct a one-stage analysis, i.e., they directly examine the association between firm performance and the risk incentives without considering managers' selection of project risk. One reason for this is that those studies are either located in the domain of traditional agency studies, which assume that managers are risk averse and managers' risk taking behaviour can reduce agency costs and enhance shareholder value, or although they might be located in the domain of behavioural finance, these studies take for granted that managerial risk taking induced by managers' overconfidence/over-optimism/hubris can only lead to value destruction for shareholders. Therefore, it appears that managers' selection of project risk has not received much attention in the existing finance literature. When bringing the traditional agency view and behavioural agency view together and allowing for both managerial risk avoidance and excessive risk taking, one can not simply assume that managerial risk taking will for sure increase firm value. The importance of examining managerial risk taking is therefore self-evident. This is the reason why this thesis conducts a two-stage analysis of the relationship between firm performance and risk incentives.

This thesis employs managers' choice of high-risk high-tech acquisitions as a proxy for managerial risk taking. Acquisitions are large and visible corporate investments that can significantly alter the acquirers' risk profile. They may accentuate agency conflicts between managers and shareholders (see Section 5.2 Chapter 5 for a discussion). While diversifying acquisitions are thought to be driven by managerial preference for risk reduction (Amihud and Lev, 1981; Amihud *et al*, 1986; May, 1995), acquisitions of targets rich in intangible assets such patents or R&D, obviously ratchet up the risk of the acquirers (Kohers and Kohers, 2001). There is extensive evidence that acquirer firm shareholders do not gain from acquisitions in the short term and experience value losses in the longer term (Sudarsanam, 2003, chapter 4: Moeller *et al*, 2004; Conn *et al*, 2005). Whether such value losses are due to skewed risk incentives that managerial wealth components provide or are encouraged by managerial behavioural biases is an interesting question to resolve empirically. In this thesis therefore acquisitions are considered to be an appropriate corporate decision-making context in which to explore the relationship among managerial wealth, behavioural biases, corporate monitoring mechanisms, investment risk profiles and shareholder value gains. The two research questions thus can be readdressed as:

Q1': What are the factors that drive managers to undertake risky acquisitions?

Q2': To what extent is acquirers' post acquisition performance related to the optimal- or suboptimal-risk of acquisitions?

Sections 5.4, 5.5 and 5.6 of Chapter 5 hypothesize the relationship between acquisition risk and the components of the managerial wealth portfolio, behavioural biases and various corporate monitoring devices. Section 5.8 of Chapter 5 hypothesizes the relationship between acquirer post-acquisition performance and the levels of optimal/suboptimal acquisition risk. To test the hypotheses, this thesis conducts a five-step analysis: 1) estimating the empirical risk model to identify factors that determine acquisition risk; 2) identifying optimal- and suboptimal-risk acquisition classifications based on the predictions of the empirical risk model; 3) calculating long-term post-acquisition performance; 4) evaluating the post-acquisition performance for each acquisition risk group by conducting univariate and multiple regression analysis; 5) conducting one-stage analysis of the relationship between acquirers' post-acquisition performance and risk incentives to compare the difference between the one-stage analysis and the two-stage analysis. Those analyses are based on a sample of 589 UK domestic acquisitions over the period 1993-2000.

The results of the analyses are summarised in Section 9.2. The implications of these results are discussed in Section 9.3. The issues for further research are presented Section 9.4.

9.2 Summary of results and conclusions

This section summarizes the results of the analyses. Section 9.2.1 is the summary for Chapter 7 which aims to answer research question Q1 and Section 9.2.2 is the summary for Chapter 8 that provides answers to research question Q2.

9.2.1 Determinants of acquisition risk

Chapter 7 examines the determinants of the riskiness of acquisitions pursued by managers. In line with existing empirical evidence regarding the incentive effect of fixed compensation and annual bonuses, the thesis finds that these types of compensation provide few incentives for managers to conduct risky acquisitions and that, they can even discourage managers from pursuing high-risk high-tech acquisitions. LTIP cash also does not provide any incentives for managers to take risk.

The findings of this study with regard to equity-based wealth challenge existing empirical evidence. This thesis finds significant evidence that equity-based wealth which links managers' wealth with firm performance has a nonlinear incentive effect on managerial risk taking. It uses the partial derivative of the value of managers' equity holdings relative to 1% change in firm stock price (indicating the association between firm performance and managers' wealth) as a measure of the incentive provided by managers' equity holdings. It finds that a small equity delta, meaning a low association, encourages managers to buy high-tech targets because the technology brought by target firms can enhance the competitive advantage of acquirers, and thus improve the value of the acquiring firms as well as the value of managers' equity holdings. However, if acquisitions fail, it will not make managers suffer a great loss because their wealth is not closely linked to firm performance. This positive association between managerial risk taking and equity delta however diminishes and turns negative as delta becomes large. This is because when equity delta is high, managers' wealth is highly exposed to firm stock price variations while managers do not want to expose their wealth to too much risk. A further increase in the association between managerial wealth and firm performance can only intensify managers' risk aversion and divert them away from high-risk high-tech acquisitions.

Various robustness checks show that the significant incentive effect of equity delta is mainly from managerial equity ownership, not from LTIP shares or stock options. Unlike many US studies which report that stock options can reduce managerial risk aversion because through them managers can always benefit from rising stock prices, but are protected from wealth loss as a result of plunging stock prices. Stock options therefore have a convex payoff structure. The convexity of stock options is measured by vega, which is the partial derivative of the value of stock options relative to 1% change in stock return volatility. The convexity of stock options therefore should contribute to managerial risk taking. Many studies even argue that the convexity of stock option can induce managers to engage in excessive risk taking (see Section 2.3.4.2 of Chapter 2). This thesis however does not find any significant effect of stock options on managers' selection of acquisition risk.

The limited impact of compensation on managerial risk preference is consistent with the argument put forward by Ross (2004) that managerial risk preferences cannot easily be altered by compensation contracts. Ross suggests that managerial risk propensity is affected by managers' individual utility functions, which can have a greater or lesser risk aversion depending on factors such as managers' total wealth. Managers are more risk averse at a high level of wealth than at a low level of wealth. A high level of managerial wealth therefore weakens the incentive alignment effect of equity-based compensation. This argument is supported by this thesis which finds that when managers' wealth level is high, the incentive alignment effect of managerial equity holdings is weakened. Managers tend to select low-risk acquisitions[161].

The limited impact of equity-based compensation on managerial risk taking may be due to the low level of equity-based compensation in the UK. Unlike in the US where executive compensation was dominated by stock options in the 1990s, this thesis shows that UK directors' stock option holdings and the holdings of LTIP shares fall behind or are at most close to the value of cash compensation in the 1990s. It is therefore not hard to understand why no strong evidence is found with regard to the incentive effects of LTIP shares and stock options. The broad criticism of excessive stock option grants inducing managerial excessive risk taking in the US in the 1990s does not apply to the UK.

I acknowledge that in this thesis a less than ideal design of the empirical test may also bias conclusions regarding the incentive effects of the components of managerial wealth. Detailed discussions with regard to this can be found in Section 9.3 below. Moreover, executive compensation in companies can be manipulated by executive directors and thus is unlikely to provide proper incentives (see Section 7.4.1 of Chapter 7).

Overall the results suggest that the components of managerial wealth induce more managerial risk aversion than managerial risk seeking. In fact, what drove UK

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[161] I acknowledge in Section 7.4.1 of Chapter 7 that the data in this study is not able to demonstrate a significant difference between the risk aversion impact of a high level of managerial equity holdings and the risk disincentive effect arising from a high level of managerial wealth. This is because the major component of managerial wealth is managerial equity holdings.

directors in the 1990s to pursue high-risk high-tech acquisitions was their behavioural biases, which caused them to overestimate their own capability but underestimate acquisition risk.

This thesis finds fairly strong evidence that managerial overconfidence/over-optimism/hubris boosted by good past performance, glamour rating by the stock market, and flattering media profile induces managers to engage in risky high-tech acquisitions. These effects are stronger during stock market booms than at other times. This is consistent with the argument put forward by behavioural finance theory that managers can be risk seeking even without the inducement of stock options.

In line with empirical evidence presented in Chapter 4 that corporate control devices are generally ineffective because managers are in effective control of companies, this study finds that monitors such as external blockholders or institutional investors generally do not have any impact on managers' selection of acquisition risk. Board structure variables such as board independence, separation of the roles of CEO and COB, and the existence of a remuneration committee have no strong impact on managers' choices of acquisition risk.

In addition to factors above (the main focus of this thesis), I also find that acquirer financial leverage, acquirer size, and relative size of acquirer to target, which are factors argued by existing literature to have an impact on managerial risk taking have no impact on managers' pursuit of acquisition risk.

In summary, this thesis finds that what makes managers take risky acquisitions appears to be internal factors, i.e., factors that work within managers' inner selves and give them more confidence that they can controlling risks. External factors, such as corporate governance devices that try to control managers' behaviour, do not necessarily boost managers' confidence in their risk managing capabilities. These results imply that managers who do not have good past performance or who do not receive flamboyant media praise, are likely to remain risk averse and demonstrate risk avoidance behaviour.

9.2.2 Post-acquisition performance and acquisition risk

Having empirically modelled the determinants of acquisition risk in Chapter 7, in Chapter 8 I derive the level of optimal/subopitmal acquisition risk and examine the association between acquirer post-acquisition performance and the level of optimal/subopitmal acquisition risk in Chapter 8. This is done to address research question Q2.

An examination of acquirers' buy-and-hold-abnormal-returns shows that high-tech acquisitions in the UK during the 1990s destroyed shareholder value up to three years after acquisition completion. This is inconsistent with the findings of Conn *et al* (2005) who find that high-tech acquisitions of privately-held targets[162] neither create nor destroy shareholder value. This thesis does not find strong or consistent evidence that high-risk high-tech acquisitions destroyed more value than low-risk, low-tech acquisitions. On the contrary acquirers which bought low-tech targets underperformed firms that acquired high-tech targets, although the difference was not always statistically significant.

This thesis also show that acquirer post-acquisition performance can be partially explained by the risk level of acquisitions even though the relationship is not predicted exactly in Section 5.8 of Chapter 5. Specifically, over the period 1993 to 1997,

[162] More than 90% of the target firms in the sample of this thesis are non-listed companies.

acquisitions that are identified as being at an optimal-risk level perform much better and generate much more value for acquirer shareholders than acquisitions that are classified as under-risk acquisitions. Such a clear picture however, is not found in the 1998-2000 sample, during which time, optimal-risk acquisitions perform only slightly better than under-risk acquisitions. Indeed more shareholder value is created in acquisitions that are over-risk acquisitions than in either optimal-risk or under-risk acquisitions during that period. This perhaps unexpected result is in fact consistent with the findings of the empirical risk model. With the exception of overconfident/over-optimistic/hubris managers, UK managers are likely to exhibit risk aversion, particularly when corporate governance is not effective in encouraging them to take more risks (see previous section). These findings suggest that during the sample period UK acquirer managers may have foregone valuable but high risk growth opportunities and destroyed or failed to create shareholder value by being excessively risk-averse rather than by being adventurous in their risk choices.

In addition, this thesis does not find any significant evidence that non-cash offers destroy more shareholder value than cash offers do in acquisitions.

So far I have discussed findings based on the two-stage analysis of the relationship between post-acquisition performance and the factors that influence managers' choices of acquisition risk. To provide a study comparable with the commonly published one-stage analysis of such a relationship, I run regressions of acquirer 3-year buy-and-hold-abnormal-returns directly on risk incentives (i.e., the one-stage analysis) and conduct various robustness checks just as I do with the two-stage analysis. The results show that none of the risk incentive factors strongly explain post-acquisition performance, and the explanatory powers of the regression models are weak.

Therefore, it appears that a two-stage analysis, which considers managers' selection of acquisition risk, can explain post-acquisition performance more fully than a one-stage analysis. The two-stage analysis provides insight into the linkage among risk incentives provided by managers' wealth, managerial risk taking and the consequent firm performance. It also allows us to examine how managerial behavioural biases affect this linkage.

9.3 Implications

The findings of this thesis have several implications not only for empirical finance research but also existing corporate governance designs. Firstly, this thesis challenges the view of the traditional agency model that managers are naturally risk averse. Consistent with the view of the behavioural agency model, it suggests that managers can be risk seeking as well as risk averse. The implication is that classical finance research needs to include behavioural bias variables into empirical models when assessing managerial risk taking.

Secondly, this thesis suggests that a one-stage analysis of the relationship between firm performance and factors that influence managers' investment behaviour is not as good as a two-stage analysis which considers managers' selection of project risk. A two-stage analysis provides insight into such a relationship and explains firm performance more fully than a one-stage analysis.

Thirdly, this study shows that managerial equity holdings which link managers' wealth to firm stock performance, can have a concave impact on managers' risk taking behaviour. When the managerial equity holdings are low, they encourage managers to take risky acquisitions. However when they are high, they divert managers away from high-risk acquisitions. This evidence is found when the risk incentives provided by managerial equity holdings are measured by the sensitivity of managers' equity holdings to 1% change in firm stock price. Further, this study shows that the concave impact of managerial equity holdings comes mainly from managerial shareholdings, rather than LTIP shares and stock options since the grants of these two compensation plans far too low to significantly influence UK directors' investment behaviour in the 1990. It is suggested that future studies should further examine the nonlinear impact of managers' equity holdings.

Fourthly, this thesis shows that a high level of managerial wealth which intensifies managerial risk aversion can diminish the incentive alignment effect of managerial equity holdings. Empirical studies should not neglect this when examining the incentives provided by managerial equity holdings.

This thesis also has implications for corporate governance practices. It suggests that executive compensation in the UK induces more managerial risk aversion than managerial risk seeking. Stock options which should encourage managerial risk taking are too low as a proportion of executive compensation to have any strong incentive effect on managers. However, an excessive amount of stock options or other equity-based compensation may not be all good because it appears that they bring about both a risk-seeking effect and a risk-aversion[163] effect simultaneously. The tradeoffs between

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[163] Ross (2004) argues that increased stock option grants also increase managers' total wealth. Managers are more risk averse when their total wealth level is high than when it is low (see Section 2.4.2). This thesis provides empirical support that a high level of managerial wealth weakens the incentive alignment effect embedded in managers' equity-based wealth (see previous section for a summary of the findings of this thesis).

these two effects may mean that equity-based compensation is not usefully but brings more agency costs to shareholders.

In addition, this thesis finds that UK boards generally adhere to the recommendations in the Cadbury Report (1992) that the roles of chief executive officer and chairman of board should be separated, that the board should have a remuneration committee, and that boards should be dominated by non-executive directors. However this thesis still finds that corporate control by those monitors is largely ineffective, therefore it advocates a re-think of corporate monitoring systems in the UK.

9.4 Issues for further research

Throughout the course of this work a number of issues were encountered which may compromise to a greater or lesser degree the conclusions drawn using the models presented in this thesis. These issues and recommendations to future researchers are listed below.

Firstly, the risk model is purely empirically based. In the absence of a theory specifying the relevant observable variables, the empirical risk model may be subject to an omitted-variable problem. Further research, therefore, should investigate any other variables that might have been neglected from the empirical risk model presented in this thesis.

A second issue is that compensation designs may be endogenous. Empirical literature suggests that the design and structure of executive compensation can be determined by firm size, past performance, tax, leverage, growth opportunities, cash flow, etc (Baker *et al*, 1988; Jensen and Murphy, 1988; Scholes, 1991; Long, 1992; Smith and Watts, 1992; Graver and Graver, 1993; John and John, 1993; Yermack, 1995; Core and Guay, 1999; Mishra *et al*, 2000; Hanlon *et al*, 2003; Ittner *et al*, 2003).

Moreover, equity ownership is exogenously determined by size, monitoring difficulty, etc (Demsetz and Lehn, 1985). Board composition is also argued to be determined by firm performance, CEO turnover, and changes in ownership structure (Hermalin and Weisbach, 2003). A better risk model should include simultaneous equations for all of these endogenously determined variables. However, this is a large area of research and it is beyond the scope of this thesis to consider all of these endogenous variables when constructing the risk model. It is therefore left for the future development of this thesis.

The third issue is that the acquisition risk proxied by the target high-tech acquisition status or target industry R&D intensity cannot fully quantify acquisition risk. A better measure is likely to be target firm level data. Given that more than 90% of the target firms in the sample of this thesis are unlisted companies whose accounting information on intangible assets is not available from public sources, it is impossible to employ a target firm level data (see Section 6.2.1.1 of Chapter 6). Further research should use target firm level data. Future studies should also use some other risk measures for sample, the stock volatility change of acquirers after acquisitions, and other types of investment projects.

In addition, the definitions of high-tech and low-tech industries based on the definitions of Securities Data Company (SDC) are subject to more robustness checks, although as shown in Table 7-1 in Chapter 7, high-tech targets defined by SDC have substantially higher industry R&D intensity than low-tech targets. Conn *et al* (2005) use R&D expenditure to industry output to define high-tech industries and low-tech industries (see Section 6.2.1.1 of Chapter 6). Future studies are recommended to use different measures for high-tech industries.

The fourth issue is that long-run post-acquisition stock returns may be a noisy performance measure. Stock-based performance measures rely on the assumption of efficient markets to properly assess the gains arising from an acquisition (Healy *et al*, 1997). A violation of this assumption will lead to a wrong estimation of the outcome of an acquisition. An alternative approach is to use accounting-based performance measures although such an approach is also biased because accounting data can be manipulated by managers to give the impression of better firm performance.

This thesis uses a control firm approach[164] to identify benchmarks firms. This approach can alleviate new listing, rebalancing, and skewness biases (see Section 6.5.3.3). The control firm approach, however, is not without any problems. For example, like any other benchmark models, it is subject to model misspecification problem (Lyon *et al*, 1999). If the benchmark model is not properly specified, for instance, some important pre-event characteristics are not included in the benchmark, the resulting abnormal returns could still be spurious. Therefore, future research should use different firm characteristics, and different benchmarks such as asset pricing models for robustness checks.

Fama (1998) argue that bad model problems are more acute with long-term buy-and-hold-abnormal returns (BHARs) because of the compounding effect of the BHAR approach (see Section 6.5.3.4 of Chapter 6). If a benchmark model is not appropriate, i.e., a bad model, compounding the expected returns can exacerbate the error. Further research should use cumulative abnormal returns (CARs) or calendar time abnormal

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[164] A control portfolio approach is also used in this thesis. However, Barber and Lyon (1997) argue that a control portfolio approach is subject to new listing, rebalancing and skewness biases, so is an asset pricing model. See Section 6.5.3 of Chapter 6 for discussions of those problems.

returns (CTARs), both of which do not compound abnormal returns, for robustness checks[165].

Cross-sectional dependence[166] of stock returns which lead to mis-specified test statistics for abnormal returns exists in the BHARs reported in this thesis because of the overlapping event windows of the sample acquisitions. 41% of the sample acquisitions (235 acquisitions out of 578 acquisitions) are multiple acquisitions[167]. Conn *et al* (2005) report 87% (3340 out of 3842 acquisitions) of their sample acquisitions are multiple acquisitions and find that CTARs and BHARs produce similar results. Although the percentage of multiple acquisitions in the sample of this thesis is much lower than that in the study by Conn *et al* (2005), it is still recommended that further research should use CTARs for robustness checks.

The fifth issue is as mentioned in Section 7.4.1 Chapter 7, the Black and Scholes (1973) formula may overstate the value of options to risk averse executive recipients. In addition, the insufficient information disclosure[168] for executive stock options in the UK also distorts the true value of the option holdings of UK directors. It is not only stock options that have measurement problems, the pay-performance sensitivity of LTIP

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[165] CARs and CTARs also have problems. See Section 6.5.3.4 for a discussion.

[166] See Section 6.5.3 of Chapter 6 for discussions of those problems.

[167] Multiple acquisitions in this thesis refer to acquisitions conducted by the same acquirer within 3 years.

[168] UK companies can adopt two types of disclosure of directors' holdings of stock options, complete disclosure and concise disclosure. A complete disclosure reports all the parameters in Black-Scholes (1973) option pricing model. A concise disclosure may only report the weighted average exercise price for the unexercised options held by directors instead of the exercise price for each tranche of stock options. Researchers have to make some assumption about those parameters if a company follows a concise disclosure. See Section 6.2.1.2 for more discussion.

shares (i.e., LTIP delta) is also calculated based on the assumption that LTIP shares have a delta of 1 while the true value may actually vary from 0 to 1[169]. Further research should employ different option pricing models that can incorporate the characteristics of executive stock options, such as an option pricing model for American-Style stock options, and should use a better approach for estimating LTIP delta.

The sixth issue is that although the measure of managers' total wealth includes the managerial wealth associated with their employment firms, it does not include managers' wealth invested outside of their firms. Therefore, in this study, the risk aversion effect from total wealth may be underestimated. Future research should include as much information about the total wealth of managers as is reasonably possible.

The seventh issue is that as discussed in Section 7.4.2, psychological biases are difficult to quantify. In general, the proxies for managerial behavioural biases are noisy and subjective. Further empirical studies are recommended to examine the robustness of the measures used in this thesis and to suggest more proxies. Regarding the content analysis conducted for the media praise variable, it is recommended that future studies should use more than one researcher to read and identify the relevant articles. The coding of identified relevant articles can be conducted by both researchers and computer software to achieve better accuracy than by only one researcher like in this study.

Furthermore, as discussed in Section 8.7 of Chapter 8, the conclusion drawn in this thesis that risky high-tech acquisitions which are mainly driven by managerial behavioural biases, can create value for acquirer shareholders is sample-specific and time dependent. Using a US sample which includes a period of excessive stock option

[169] See Section 2.3.3 of Chapter 2 for discussions of LTIP delta.

grants, researchers will probably find that stock options are one of the driving forces for high-risk high-tech acquisitions. If the post-2000 period after the stock market crashed is included in the sample, the strong evidence for managerial overconfidence/over-optimism/hubris inflated by their firms' superior stock performance and flattering media profiles may not be found.

Despite these areas for improvement in this thesis, it is the first piece of empirical research that combines the views of traditional agency theory and behavioural agency theory to examine managerial risk taking behaviour. This study draws upon and contributes to agency literature, executive compensation literature, corporate governance literature, and M&A literature. This exploratory study will serve as a useful foundation for future research into the understanding of what factors influence managerial risk taking, and how, in turn, it influences corporate performance.

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